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LINAS JASIUKEVIČIUS

THE ASSESSMENT OF PUBLIC-PRIVATE PARTNERSHIP'S POSSIBILITIES TO OPTIMIZE INVESTMENTS IN PUBLIC INFRASTRUCTURE

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LINAS JASIUKEVIČIUS

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EXPLANATION OF ABBREVIATIONS AND SYMBOLS

Capex – Capital expenditure is the money an entity spends to build, buy, improve and fix a long-term asset.

CAPM – Capital asset pricing model describes the relationship between risk and expected return and which is used in pricing risky investments and for discounting.

CBA – Cost-benefit analysis is a systemic approach to evaluating and comparing cost and benefits of the possible to implement alternatives of the investment project.

CCF – Cumulated cash flow that is the sum of all of the net cash flows that have been generated by an entity since inception.

CDF – Cumulative distribution function, which calculates the cumulative probability for a given x value and which is used in the dissertation to determine the probability that the cost of investment project implementation will be lesser than or equal to a certain value.

CDS – Credit default swap, which is a particular type of swap used to transfer credit exposure between two or more parties, which can also be used to calculate risk premium for discounting under the CAPM-based approach.

CEA – Cost effectiveness analysis is a method of analysis which compares the relative costs to the outcomes of two or more alternatives of IP implementation.

CF – Cash flow, or the amount of cash moving into and out of the IP.

CL – Contingent liability is a possible obligation arising from past events and depending on uncertain future events. Contingent liability may cause additional cost of IP implementation.

CN – Competitive neutrality is costs that are added to public sector's scenario of IP implementation to make state-owned and private entities competing on a same-level playing field.

CP – Conventinal procurement is traditional purchase by governments and state-owned enterprises of goods, services and works.

CPI – Consumer price index is an indicator that measures changes in the price level of consumer goods and services.

CSFs – Critical success factors are elements necessary for an investment project to be implemented as the PPP.

EC – The European Commission is an institution of the EU responsible for a complex of tasks such as proposing legislation, implementing decisions and managing the day-to-day operation of the EU.

ECB – The European Central Bank is an institution of the EU managing the euro, framing and implementing monetary policy of the EU.

EIB – The European investment bank is an institution of the EU providing funding for projects which help to achieve the aims of the EU, both within and outside the EU.

ENPV – Economic Net Present Value is an indicator which measures net socio-economic benefits of possible alternatives of IP implementation.

EPEC – European PPP Expertise Centre is an initiative involving the EIB, the European Commission and European Union Member States and Candidate Countries for strengthening the capacity of its members to enter into PPP transactions.

ERR – Economic Rate of Return is a metric used in economic assessment of the IP measuring the socio-economic usefulness of its possible alternatives.

ESI fund – European structural and investment funds.

EU – the European Union.

FDR – Financial discount rate is a rate used to discount the future cash flows.

$FNPV_c$ – financial NPV on investment (costs) is defined as the sum that results when the expected discounted investment and operating costs of the IP are deducted from the discounted value of the expected revenues.

$FOPS_{max}$ – Maximum financial obligations of the public sector are the maximum financial obligations of the public sector rational to assume in the PPP. Any larger obligations above this threshold mean that PPP does not provide VfM to the public sector in respect of cost efficiency.

$FOPS_{rtn}$ – Maximum financial retained obligations of the public sector is the maximum amount of risk rational to assume to the public sector.

FV – Financial viability is the ability to generate sufficient income to meet the cost of IP implementation being affordable to the PPA and satisfying the financial requirements of stakeholders.

GA – Governmental authority is the government of a country, its its any subdivision, state or local authority, any agency, regulatory body that has administrative power or function of or pertaining to government.

ICOR – Investment cost overrun risk.

ICT – Information and communications technologies.

IP – Investment project is a document which financially, economicaly, technically and socially validates the goals of investments, evaluates the financial and socio-economic return on investments and other indicators of efficiency, indicates the financing (funding) needed as well as the financial resources and dates of IP implementation.

JV – Joint venture is a cooperative enterprise entered by at least one entity of the public sector and one or more private entities to implement a specific IP of public infrastructure and deliver services; as owners contribute assets, they have equity according to which the management rights of the enterprise are shared proportionally.

LCC – Life cycle costing is a costing technique that considers all costs of IP implementation and during the economic life of the developed asset (construction, purchase price, installation, operation, maintenance, repair, disposal, etc.)

LRG – Loan repayment guarantee is a promise of the PPA to assume a limited or unlimited debt obligation of the private entity, if the private entity defaults.

MARF – Marginal annual revenue flow is the sum of revenue, above which the private entity has to share the revenues at a determined ratio with the PPA in the PPP.

MCA – Multi-criteria analysis, which is an analytical method which aims to compare different actions according to multiple criteria.

MP_{pr} – Maximum payment for the private sector in the PPP, which is the maximum payments to the private sectors for transferred tasks including associated risks, above which the PPP becomes financially irrational.

NFB – Non-financial benefit is a benefit which improves the quality of infrastructure and service delivery and/or makes them being earlier accessible, which is relevant to customers.

NPC – Net present costs is the present value of all costs of IP implementation and service delivery throughout the economic life of investments.

NPM – New public management is an approach used in the public sector to modernise it by applying practice and innovation of the private sector.

NPV – Net present value is the present value of CFs received from the IP compared to the initial investment and the present value of other expenditure related to IP implementation at the required rate of return.

O&M – Operation and management is a form of PPP.

OECD – the Organization for Economic Co-operation and Development.

Opex – Operational expenditure, which include all cost related to the operation and maintenance of an infrastructure and provision of services.

Optimization – Maximization of benefits the public sector can potentially get through alternative ways of implementing investments considering various technical, legal, financial and social restrictions.

PaS – Parking space, which is a location specially designated for parking.

PCIP – Public capital investment programs is a program which funds the public IPs.

PD – Probability distribution is a statistical function which relates all the possible values with their likelihoods and according to which a random variable can take a value within a given range.

PFI – Private Finance Initiative is a form of PPP.

P-I – Probability-impact method used to assess risk.

PPA – Public procurement authority can be any entity of the public sector which purchases assets and services according to the rules of public procurement.

PPP – public-private partnership, generally considered as an alternative way of public procurement and delivery of public infrastructure and services.

PS – Public service is a service such as transport, education, health care, etc. provided by the government or municipality to people in its jurisdiction.

PSC – Public sector comparator is a tool used by PPAs to make a decision by testing whether a PPP offers VfM in comparison with the most efficient scenario of the public sector.

Pu. S. – Public sector is a portion of an economic system which is controlled by the government.

RC – Risk case represents the outcome which deviates from the most likely scenario and causes loss.

RF – Risk factor, which can cause a risk event.

RFP – Request for proposal is a document which contains information that bidders could fully understand regarding what is required and expected in a particular public procurement. Typically, it includes information about the PPA, requirements and scope of the IP, bidder qualification requirements, timeline, guidelines for the proposal and other information.

RG – Risk group is a group of risks which have a similar affect on the outcome.

Risk – Investment cost overrun risk.

SB – Shadow bid is a financial model of the expected PPP.

SD – Standard deviation is a measure which shows how numbers are spread out.

SDR – Social discount rate is an interest rate used in cost-benefit analyses of public IPs to calculate the socio-economic return on investments.

SGP – the Stability and Growth Pact is a set of rules designed to ensure that countries in the EU pursue sound public finances and coordinate their fiscal policies.

SPV – the Special purpose vehicle is a legal entity created for a specific purpose of IP implementation and delivery of infrastructure and services in the PPP.

UK – the United Kingdom.

UP – Unitary payment are unitary payment charges paid by a PPA to private sector consortiums for services agreed over the length of PPP contracts.

USA – the United States of America.

VAT – Value-added tax.

VfM – Value for money is somehing that is well worth the money spent on it. VfM analysis allows evaluating the benefits of PPP against the CP, accordingly VfM is a driving factor in any decision for the use of PPP.

WACC – Weigthed average cost of capital.

WB – the World Bank.

INTRODUCTION

The relevance of the research topic. The relevance of assessing the possibilities of Public-Private Partnerships (PPPs) to optimize investments in public infrastructure can be substantiated from the *scientific*, *economic*, *financial* and *social* perspectives. Most researchers (Bednarek et al., 2012; Carbonara, Costantino, & Pellegrino, 2014; Chou, Ping Tserng, Lin, & Yeh, 2012; Ke, Liu, & Wang, 2008; Kurniawan, Mudjanarko, & Ogunlana, 2015; Moszoro, 2010, 2014; Sarmento & Renneboog, 2016; Yin Wang, 2015; Yinglin Wang & Liu, 2015; Xu et al., 2012; Xueqing Zhang, 2011) highlight the importance of development of the assessment tools which would allow to complexly assess the most effective ways and forms as well as determining the optimal conditions of provision of public infrastructure and services.

A numerous amount of literature (Ball, 2011; Gouveia & Raposo, 2012; Khadaroo, 2008; Lopez-Lambas & Monzon, 2010; Martins, Marques, & Cruz, 2011; Moro Visconti, 2014; Poulton & Macartney, 2012; Wojewnik-Filipkowska & Trojanowski, 2013) is focused on the empirical researches of possibilities of the private sector to increase the efficiency and quality of public services' delivery. Within the PPP context, the concept of Value for Money (VfM) is widely recognized as the primary measure of PPP's efficiency and it is used as the main justification for choosing public or private financing for delivering public infrastructure and services (Liu, Love, Smith, Regan, & Palaneeswaran, 2015; Martins et al., 2011; Shaoul, 2005; N. Wang, 2014). A wide range of literature on the topic indicates (Burke & Demirag, 2015; Grimsey & Lewis, 2005; Harada & Ogunlan, 2015) that the PPPs, compared with the methods of conventional procurement (CP), can deliver better VfM. Since it is considered only as a possibility, it is commonly agreed that for the implementation of PPP, its VfM should be clearly demonstrated. Many studies disclosed the importance of assessing the critical success factors (CSFs) (S. T. Ng, Wong, & Wong, 2012; Song, Wang, & Cavusgil, 2015; Andreas; Wibowo & Alfen, 2015), the use of public sector comparator (PSC) (Fernandes, Ferreira, & Moura, 2015; Gupta, Gupta, & Agrawal, 2013; Tsamboulas, Verma, & Moraiti, 2013; Yin Wang, 2015), structuring the optimal PPP contract in respect of financial viability and affordability (Bednarek et al., 2012; Gasiorowski & Moszoro, 2008; Lu, Peña-Mora, Wang, Shen, & Riaz, 2015; Moszoro, 2010), concession period (Bao, Peng, Ablanedo-Rosas, & Gao, 2014; Hanaoka & Palapus, 2012; Yu & Lam, 2013; Khanzadi, Nasirzadeh, & Alipour, 2012; S. T. Ng, Xie, Cheung, & Jefferies, 2007; Xueqing Zhang, 2011), concession pricing (Qiu & Wang, 2011; Xu et al., 2012), payment mechanism (Asao, Miyamoto, Kato, & Diaz, 2013; Burke & Demirag, 2015; Felix; Villalba-Romero & Liyanage, 2016) and risk sharing and allocation (Fischer, Leidel, Riemann, & Alfen, 2010; Jin & Zhang, 2011; Takashima, Yagi, & Takamori, 2010) to achieve VfM. Otherwise, the lessons learnt over the last two decades have disclosed (D. Hall, 2015; Olalekan & Hashim, 2014; Spackman, 2002; Xueqing Zhang, 2011) that the implementation of PPP's without sufficient economic and

financial justification may lead to financial, economic and social problems in the future.

Many academics emphasize the importance of assessing the possibilities to optimize public investments by attracting the resources of the private sector and know-how from the *economic perspective*. The researches (Anwar, 2006; Benito, Montesinos, & Bastida, 2008; Berawi et al., 2014; Bin & Quan, 2012; Bom & Ligthart, 2014; Carranza, Daude, & Melguizo, 2014; Clark & Root, 1999; Daido & Tabata, 2013; Duran-fernandez & Santos, 2014; Esfahani & Ramírez, 2003; Glomm & Ravikumar, 1999; M. R. Gupta & Barman, 2010; Heijdra & Meijdam, 2002; Herranz-Loncán, 2007; Hosoya, 2014; Kateja, 2012; Khandelwal & Khanapuri, 2015; Mamatzakis, 2003; Mejia-Dorantes & Lucas, 2014; Melo, Graham, & Brage-Ardao, 2013; Mota & Moreira, 2015; Percoco, 2014; Pradhan & Bagchi, 2013; Shi & Huang, 2014; Tamai, 2014; E. C. Wang, 2002; Zawawi, Ahmad, Umar, Khamidi, & Idrus, 2014) argue that the provision of public infrastructure, which requires continuous capital investments to expand and maintain, is a must for the country's economic growth and competitive ability. Here public infrastructure is considered such infrastructure as facilities, structures, equipment, services and institutions that are owned by the public or is for public use and are essential to the economy and quality of life of a nation, region or city. Therefore, by implementing investments the governments are responsible for the development of infrastructure to the level which would satisfy the needs of society and would provide a basis for economic development. Accordingly, the investment in public infrastructure is highlighted as an important aspect in the public sector's economics. While other researchers (Agénor, 2010; Mu, Jong, & Koppenjan, 2011; Sambrani, 2014; Wojewnik-Filipkowska & Trojanowski, 2013) indicate a lack of public funds and governments' capacity to satisfy all infrastructural needs of the countries.

A large number of literature (Akhmetshina & Mustafin, 2015; Esteve, Ysa, & Longo, 2012; S. T. Ng et al., 2012; Reeves, 2005; Willoughby, 2013) on economic rationale for the assignment of more responsibility to the private sector claims that the PPP can release governments' tight budgetary pressure, enhance productivity, encourage innovations, improve cost effectiveness, allow better risk allocation and increase VfM. A growing PPP market worldwide (PPIAF, 2016) shows that the PPP plays an important role in the development and maintenance of the public infrastructure and services. Considering the increasing number of PPP contracts, many researches (Chatterjee & Mahbub Morshed, 2011; Sarmento & Renneboog, 2016; Yin Wang, 2015) also emphasize the change of the public sector's role. The PPP allows the public sector to be no longer a provider of public infrastructure and services and focus more on the functions of their strategic planning and regulation instead.

However, according to Boyer & Newcomer (2015), Gordon, Mulley, Stevens, & Daniels (2013). A. Gupta et al. (2013), Hwang, Zhao, & Gay (2013), S. T. Ng et al. (2012), Yin Wang (2015), Andreas; Wibowo & Alfen (2015) much of the success of PPP depends on the government's skills and abilities to identify and balance the interests of all stakeholders as well as to assess the expected value of going into the

PPP and, in case of positive results of VfM assessment, to construct the very PPP contract, encouraging the right incentives from all the stakeholders.

While the results of empirical studies (Ahmed & Ali, 2006; Babatunde, Perera, Zhou, & Udeaja, 2015; Janssen, Graaf, Smit, & Voordijk, 2016; S. T. Ng et al., 2012) reveal that the PPP is likely to be considered as very complex by governments. Many still existing barriers, including the lack of expertise in PPP, make it challenging for governments to assess whether PPP is a feasible, affordable and the most VfM way to deliver public facilities and services.

The importance of assessing the possibilities of PPP to optimize public investments is also emphasized from the *financial perspective.* Researchers (Bin & Quan, 2012; A. H. Chen, 2002; Kateja, 2012; Liu et al., 2015; Martins et al., 2011; Mota & Moreira, 2015; Poulton & Macartney, 2012; Sarmento & Renneboog, 2016; Schepper, Haezendonck, & Dooms, 2014; Felix; Villalba-Romero & Liyanage, 2016) argue that the large up-front capital investment costs, including the associated risk required to be financed, by implementing investment projects (IPs) in traditional way on one hand and the government's budget constraints on other hand are a formidable financial challenge for governments to combine that, in turn, makes the PPP increasingly attractive to assess as a way potentially enabling to acquire and maintain the public infrastructure financially viable. This is especially relevant in the countries where the budget deficit's ceiling is restrained by artificially created rules such as the rules for the member states on budget deficits and debt under the Stability and Growth Pact (SGP) in the European Union (EU) (Benito et al., 2008; Fernandes et al., 2015; Kellermann, 2007; Shaoul, 2011).

Many other financial benefits possible to reach in the PPP are listed by Carbonara et al. (2014), Daito & Gifford (2014), de Jong, Mu, Stead, Ma, & Xi (2010), Liu et al. (2015), Shaoul (2005), Wojewnik-Filipkowska & Trojanowski (2013), who have a unanimous opinion that the PPP is not a silver bullet and it does not outright mean the financial benefit.

Literature on the financial VfM assessment discloses various critical aspects associated with the private participation needed to be assessed to make a decision for the most appropriate financing model for the provision of public infrastructure and services. The most discussed among them are: whole-life cost saving (Carmona, 2010; Clark & Root, 1999; Daito & Gifford, 2014; Parker & Hartley, 2003; Schepper et al., 2014; Thomas Ng, Xie, Skitmore, & Cheung, 2007), assessment and allocation of risk (Burke & Demirag, 2015; Chang, 2014; Chou et al., 2012; Hwang et al., 2013; Jin & Zhang, 2011; Ke, Wang, Chan, & Lam, 2010; Lehtiranta, 2014; N. Wang, 2014), formation of capital structure formation (B. L. Chen, Liou, & Huang, 2012; Khmel & Zhao, 2015; Moreno, López-Bazo, & Artís, 2002; Moszoro, 2014; Mu et al., 2011), structuring of payment and compensation mechanism (Evenhuis & Vickerman, 2010; Gordon et al., 2013; Khmel & Zhao, 2015; Morales, Gendron, & Guénin-Paracini, 2013; Felix; Villalba-Romero & Liyanage, 2016; Zawawi et al., 2014) and determination of the concession period (Bao et al., 2014; Carbonara et al., 2014; Hanaoka & Palapus, 2012; Yu & Lam, 2013; Khanzadi et al., 2012; S. T. Ng et al., 2007; L. Shen, Bao, Wu, & Lu, 2007; Xueqing Zhang, 2011). The ongoing debate regarding the appropriate assessment of these and other

financial aspects shows that the VfM assessment within the PPP context is one of the most important issues in the theoretical project finance also resulting in the absence of a universally accepted empirical practice (EPEC, 2015b). Wojewnik-Filipkowska & Trojanowski (2013) argue that the choice of the most appropriate financial model is one of the key issues with public investments. While Zangoueinezhad & Azar (2014) emphasize the importance of developing a favorable environment to soundly assess the most effective ways of implementing public investments. According to Carbonara et al. (2014), Sarmento & Renneboog (2016), Wang (2014), the development of reliable tools and techniques which enables to objectively measure VfM in the PPP is an inherent part of this process.

It is also important to assess the possibilities of PPP to optimize public investments from the s*ocial perspective* because governments' decisions regarding the most effective ways of providing public infrastructure and services have an impact on communities' possibilities to have more or/and better qualitative public services for the same or lower costs that, in turn, affects the social welfare (Diana, 1995; Kellermann, 2007; Mamatzakis, 2007; Maskin & Tirole, 2008; Sambrani, 2014; Silvestre, 2012). Abednego & Ogunlana (2006) argue that the PPP may offer a long-term sustainable approach to improving the social infrastructure, enhancing the provided value of public assets and making the better use of taxpayer's money. Accordingly, the assessment of additional social benefits available in PPPs is an inherent part of the complex VfM assessment, of which reliable and transparent performance also makes it easier to be accepted by the society (Babatunde et al., 2015; S. T. Ng et al., 2012).

The relevance of assessing the possibilities of PPP to optimize public investments is also emphasized from the *scientific perspective,* because the assessment of the most beneficial way of implementing public investments within the context of PPP is still a methodologically complicated process. While scientific literature does not provide any models enabling to complexly evaluate the possibilities of PPP to optimize investments in public infrastructure. Although the PPP is widely analyzed and the assessment of its possibilities to increase VfM in developing and maintaining public infrastructure and services attracts a lot of attention in the academic literature (Ball, 2011; Carmona, 2010; Clark & Root, 1999; Dunn-Cavelty & Suter, 2009; Forsyth, 2005; Gudelis & Rozenbergaitė, 2004; Iseki & Houtman, 2012; Macário, 2010b; Maskin & Tirole, 2008; Molen, Vilys, Damkus, & Jakubavičius, 2010; Mu et al., 2011; Olalekan & Hashim, 2014; Parker & Hartley, 2003; Percoco, 2014; Poulton & Macartney, 2012; Roehrich, Lewis, & George, 2014; Sambrani, 2014; Shaoul, 2005, 2011; Sharma, 2007; Vajdic, Mladenovic, & Queiroz, 2012; Wojewnik-Filipkowska & Trojanowski, 2013; Wong, de Lacy, & Jiang, 2012; Zawawi et al., 2014), most of researchers (Babatunde et al., 2015; Ball, 2011; Benito et al., 2008; Bernardino, Hrãebícãek, & Marques, 2010; Desgrées du Lou, 2012; Galilea & Medda, 2010; Grimsey & Lewis, 2005; Liu et al., 2015; Mota & Moreira, 2015; Poulton & Macartney, 2012; Reeves, 2005; Roehrich et al., 2014; Sarmento & Renneboog, 2016; Wong et al., 2012) argue that there is neither a generally accepted definition, nor a unique model of the PPP. The debate on the PPP definition discloses it being studied at various levels of

analysis, adopting different theoretical approaches and emphasizing diverse key dimensions. However, a review of literature on the PPP concept (de Jong et al., 2010; Evenhuis & Vickerman, 2010; Bin Yang, Yang, & Kao, 2010; Kavaliauskaitė & Jucevičius, 2009; Obrazcovas, 2010; Percoco, 2014; Roehrich et al., 2014; Sambrani, 2014; Urbonavicius, 2010; Wojewnik-Filipkowska & Trojanowski, 2013; Zangoueinezhad & Azar, 2014) indicates the attempts to detect the optimal PPP forms and schemes depending on the government's attitudes towards the scope of tasks, ownership of infrastructure, mechanism of payments and compensation to the private partner, share of risk transfer and other specific aspects.

Most researchers (Bao et al., 2014; Carbonara et al., 2014; Gasiorowski & Moszoro, 2008; Gouveia & Raposo, 2012; Kurniawan et al., 2015; S. T. Ng et al., 2007; Shaoul, 2005; L. Y. Shen & Wu, 2005; Felix; Villalba-Romero & Liyanage, 2016; Yin Wang, 2015; Xu et al., 2012) highlight the importance of developing tools and techniques which enable to form the optimal PSC and PPP options as one of the essential preconditions, which makes the comparison of these options for VfM rational. The formation of the very comparative model, in which a mix of qualitative and quantitative variables needs proper assessment is emphasized as equally important (Ball, 2011; Fernandes et al., 2015; Gouveia & Raposo, 2012; Grimsey & Lewis, 2005; Liu et al., 2015; D. Tsamboulas et al., 2013).

However, a wide range of literature on this topic (Khadaroo, 2008; Moro Visconti, 2014; Roehrich et al., 2014; Sarmento & Renneboog, 2016; N. Wang, 2014) also indicates that the VfM within the PPP context is still a difficult concept offering competing understandings, among which a complex approach as well as more considerable attempts to develop universal tools for assessing VfM of the PPP's IPs are missing.

The summative assessment of the recent scientific publications allows stating that although VfM is a key criterion of PPP's value, there is no consistency or cumulative development regarding a methodology of the systemic VfM assessment. This discloses a significant gap in scholarly and practical understandings of how the VfM assessment should be constructed and how this concept should be properly applied. Additionally, although the assessment of possibilities in respect of optimization in various contexts including the assessment of investments is a growing trend in scientific articles (Baioletti & Petturiti, 2011; Carnevale & Lombardi, 2015; Gutiérrez & Lozano, 2016; Melkonyan, Gottschalk, & Vasanth, 2017; Pavlovskis, Antucheviciene, & Migilinskas, 2017; Rutkauskas & Stasytyte, 2010; Siali, Flazi, Stambouli, & Fergani, 2016; Xili Zhang, Zhang, & Xiao, 2013), a review of academic literature discloses the assessment of PPP's possibilities to optimize investments in public infrastructure still being analyzed only fragmentally, mostly focusing on several and mostly separately analyzed aspects, such as cost analysis (Chou, 2011; Fernandes et al., 2015; Jorgensen, Halkjelsvik, & Kitchenham, 2012; Makovšek, 2014; Mirdamadi, Etienne, Hassan, Dantan, & Siadat, 2013; Okmen & Oztas, 2010; Rostami, Sepehrmanesh, Gharahbagh, & Mojtabai, 2013; Schepper et al., 2014; W. C. Wang, Wang, Tsui, & Hsu, 2012; Andreas Wibowo & Alfen, 2013), determination of financial discount rate (FDR) (Ball, 2011; Evans, 2009; Grimsey & Lewis, 2004), accounting treatment (Benito et

al., 2008; Grubišić Šeba, Jurlina Alibegović, & Slijepčević, 2014; Hodges & Mellett, 2012; Kellermann, 2007; Mota & Moreira, 2015; Sarmento & Renneboog, 2016), risk allocation (Abednego & Ogunlana, 2006; Bing, Akintoye, Edwards, & Hardcastle, 2005; Carbonara et al., 2014; Chou et al., 2012; Fredebeul-Krein & Knoben, 2010; Hoppe & Schmitz, 2010; Hwang et al., 2013; Jin & Zhang, 2011; Ke et al., 2010; Medda, 2007), etc. herewith not covering the whole assessment process as well as a full spectrum of factors important to evaluate for making reasonable decisions regarding the most effective ways of providing public infrastructure and services.

According to Buškevičiūtė & Raipa (2011), in modern society, the decision-making can be characterized by one important aspect – the use of analytical models and methodologies which are intended to streamline decision-making. However, many issues mentioned above show that PPP's possibilities to optimize investments in public infrastructure have not been sufficiently investigated yet and the appropriate tools are not fully developed, therefore, require more scientific attention.

The scientific problem and the level of its investigation. A gap in the scientific literature within the context of the assessing the possibilities of PPP to optimize investments in public infrastructure confirms the existence of a significant scientific problem in this field. The scientific discussions on the research topic is mostly concentrated on the very VfM assessment; however, neither the performance of this assessment, as such, nor the formation of rational comparative objects is sufficiently analyzed.

Scientists (Ball, 2011; Berawi et al., 2014; Burke & Demirag, 2015; Desgrées du Lou, 2012; English & Guthrie, 2003; Evenhuis & Vickerman, 2010; Fernandes et al., 2015; Gordon et al., 2013; Gouveia & Raposo, 2012; Grimsey & Lewis, 2004, 2005; Harada & Ogunlan, 2015; Khadaroo, 2008; Liu et al., 2015; Moro Visconti, 2014; Nisar, 2007; Shaoul, 2005; Siemiatycki & Farooqi, 2012; D. Tsamboulas et al., 2013; N. Wang, 2014) are mostly focused on several aspects of VfM assessment within the PPP context: disclosure of its importance for the achievement of best value, development of its performance technique based on benchmarking of PSC and PPP options, analysis of CSFs important for VfM increase, and identification of the problems related to application of the approach of VfM assessment. Regarding these aspects, issues related to the formation of optimal capital structure (Bednarek et al., 2012; Gasiorowski & Moszoro, 2008; Lu et al., 2015; Moszoro, 2010), determination of FDR (Ball, 2011; Evans, 2009; Grimsey & Lewis, 2004), assessment and optimal allocation of risks (Abednego & Ogunlana, 2006; Bing et al., 2005; Carbonara et al., 2014; Chou et al., 2012; Chung, Hensher, & Rose, 2010; Fredebeul-Krein & Knoben, 2010; Gordon et al., 2013; Hoppe & Schmitz, 2010; Hwang et al., 2013; Jin & Zhang, 2011; Ke et al., 2010; Martins et al., 2011; Medda, 2007; A. Ng & Loosemore, 2007; Li Yin Shen, Platten, & Deng, 2006), evaluation of non-financial benefits (NFBs) (Mota & Moreira, 2015) and difficulties of VfM assessment in dealing with uncertainty (Cruz & Marques, 2013; Grimsey & Lewis, 2005; Kokkaew & Wipulanusat, 2014; Lehtiranta, 2014; Loizou & French, 2012; Okmen & Oztas, 2010; Sanderson, 2012; Tirelli, 2006) are mostly analyzed. As an important factor for higher VfM achievement, authors also separately analyze the

problems related to the determination of concession period (Bao et al., 2014; Carbonara et al., 2014; Hanaoka & Palapus, 2012; Yu & Lam, 2013; Khanzadi et al., 2012; S. T. Ng et al., 2007; Xueqing Zhang, 2011), encouragement of adequate incentives from the private sector through the determination of appropriate payment and compensation mechanism (Armada, Pereira, & Rodrigues, n.d.; Asao et al., 2013; Brandao & Saraiva, 2008; Hanaoka & Palapus, 2012; Huang & Chou, 2006; Takashima et al., 2010; Felix; Villalba-Romero & Liyanage, 2016; Yinglin Wang & Liu, 2015; Andreas Wibowo, 2004; Andreas Wibowo et al., 2012; Zawawi et al., 2014), and accounting and budgetary treatment (Ashuri, Kashani, Molenaar, Lee, & Lu, 2012; Benito et al., 2008; Grubišić Šeba et al., 2014; Haslam, 2005; Hodges & Mellett, 2012). However, most of these problems and aspects are analyzed only fragmentally and the attempts to apply an integrated complex approach are very limited in literature. There are no developed models allowing to complexly assess the possibilities of PPP to optimize investments in public infrastructure and make reasonable decisions for the most efficient ways of their implementation. Here, complexity is considered through combining such aspects as the structuring of both the rational to compare PSC model and the optimized PPP model and their rational comparison, where VfM to the public sector would be assessed, including such elements as the determination of FDR, assessment of the most beneficial option for IP's implementation, assessment and allocation of risk, determination of rational scope of PPP, calculation of the public sector's obligation in the PPP, optimization of the ratio of public and private capital as well as capital structure in the PPP and others, also considering the concepts of efficiency, effectiveness, rationality, affordability and optimization.

Several arguments can be found for this situation. Firstly, although the relationships between the public and private sectors have been analyzed by many scientists (Ahmed & Ali, 2006; Ashuri et al., 2012; Babatunde et al., 2015; Ball, 2011; Benito et al., 2008; Carbonara et al., 2014; Carmona, 2010; Clark & Root, 1999; de Jong et al., 2010; Dunn-Cavelty & Suter, 2009; Grimsey & Lewis, 2005; Grubišić Šeba et al., 2014; Harada & Ogunlan, 2015; Hellowell, 2013; Iseki & Houtman, 2012; Janssen et al., 2016; Khadaroo, 2008; Lawther & Martin, 2005; Liu et al., 2015; Macário, 2010a; Molen et al., 2010; Mota & Moreira, 2015; Mu et al., 2011; Müller & Turner, 2005; Olalekan & Hashim, 2014; Parker & Hartley, 2003; Percoco, 2014; Poulton & Macartney, 2012; Reeves, 2005; Roehrich et al., 2014; Roll & Verbeke, 1998; Sambrani, 2014; Sarmento & Renneboog, 2016; Shaoul, 2011; Sharma, 2007; Silvestre, 2012; Felix; Villalba-Romero & Liyanage, 2016; Yinglin Wang & Liu, 2015; Wang, 2014; Wojewnik-Filipkowska & Trojanowski, 2013; Zangoueinezhad & Azar, 2014; Xueqing Zhang, 2011), there is neither a single definition nor a unique model of PPP, which, in turn, determines a particular uncertainty about PPP as an alternative way of developing the infrastructure and providing services and, therefore, creates a difficulty in establishing a universal and unchallenged tool for VfM assessment. Secondly, the concept of VfM is also not consensual and, depending on the approach, may include multiple elements, which are not systemized in literature. Thirdly, VfM assessment is rational only if the rational options are compared; however, the process of their formation is only

fragmentally analyzed. Finally, the very VfM assessment is just one element in the entire process of assessing the possibilities of PPP to optimize investments in public infrastructure, while neither this process nor the internal links between its above-mentioned elements are complexly analyzed as well as their role in decision-making regarding the way of implementation are revealed. Accordingly, some scientists (Ball, 2011; Gouveia & Raposo, 2012; Khadaroo, 2008; Moro Visconti, 2014) argue that due to its multifaceted and somewhat controversial nature, the VfM assessment is too complex and not transparent enough, which, in turn, encourages critiques and causes conflict over the very PPP.

Despite its central role in decision-making for the most effective way of implementing investments in public infrastructure, there is a lack of studies which would apply a complex approach and disclose the internal links between the key elements needed to be coherently evaluated to maximize VfM to the public sector in the PPP. Such researchers as Carbonara et al. (2014), Hanák & Muchová (2015), Sarmento & Renneboog (2016) state that the sound assessment of efficiency of public resources' use is considered as one of the main challenges related to public investment. Accordingly, a complex scientific problem in this field results in a need to create an integrated complex model of for assessing the possibilities of PPP to optimize investment in public infrastructure which would integrate the key elements of analysis and decision-making for the most efficient way of developing public infrastructure. Regarding the presented problematic aspects of assessing the possibilities of PPP to optimize investments in public infrastructure, **the scientific problem** of the dissertation is raised: *how to assess the possibilities provided by the PPP to optimize investments in public infrastructure that the results obtained would enable to make reasonable decisions regarding the most efficient ways for their implementation?*

The scientific problem in this dissertation is solved by: 1) emphasizing the importance of governments' role in achieving objectives to increase the efficiency in the development of public infrastructure; 2) disclosing the factors encouraging entities of the public and private sectors to go into the PPPs 3) analyzing the PPP as a possibility to optimize investments in public infrastructure as well as considering the VfM assessment as the main technique used to assess these possibilities; 4) identifying criteria allowing the public procurement authority (PPA) to identify IPs having PPP potential and therefore rational to be analyzed for implementation as the PPP, and; 5) finally developing a methodology and an integrated complex model for assessing the possibilities of PPP to optimize investments in public infrastructure. The theoretical approach of the assessment is based on the following theories of: 1) provision of public infrastructure and services; 2) welfare maximization; 3) negotiations; 4) *x*-ineffectiveness; 5) resource-based, and 6) rational choice of financial resources. The dissertation also integrates the following views of: 1) increase of efficiency of public investments; 2) collaboration of public and private sectors; 3) reliable assessment and rational allocation of risks, also considering such aspects as: 1) VfM for the public sector assessment; 2) profit maximization for the private entity, and; 3) the asymmetry of information between the private and public sectors.

The object of the research – the assessment of possibilities of PPP's to optimize investments in public infrastructure. The optimization in this dissertation is considered as maximization of benefits the public sector potentially can get through alternative ways of implementing investments considering various technical, legal, financial and social restrictions.

The aim of the research – to prepare a complex integrated model of assessing the possibilities of PPP to optimize investments in public infrastructure.

The objectives of the research are as follows:

1. To analyze the theoretical premises of the public and private sectors' collaboration in optimizing the investments in public infrastructure by disclosing a) the importance of government's role in the efficient use of public resources for the development of infrastructure, b) economic and financial aspects of optimizing investments in public infrastructure, and c) key factors encouraging the public and private sectors to collaborate;
2. To define the concept of PPP and, through the comparative analysis of its multiple forms and schemes, to reveal its peculiarities for the formation of assumptions related to the assessment of PPP's possibilities to optimize investments in public infrastructure;
3. To identify the main elements of VfM assessment within the context of PPP and to determine the key aspects to be considered as well as the factors to be evaluated to make reasonable decisions for an effective implementation of investments in public infrastructure;
4. To structure the methodological approaches of assessing the possibilities of PPP to optimize investments in public infrastructure;
5. To assess empirically the validity of the created model for assessing the possibilities of PPP to optimize investments in public infrastructure in the case of a hypothetical IP.

The methods of research

In the theoretical part of the dissertation the first three objectives are accomplished by using the *methods of scientific literature analysis, synthesis, comparison and generalization*.

The model of assessing the possibilities of PPP to optimize investments in public infrastructure is developed by using the same methods as have been used to achieve the previous objectives; however, for performance of the empirical researches, the methods of *statistical analysis* and *financial analysis and modeling* have been additionally used. The research data was processed and analyzed by using the programs of *EasyFit* and *MS Excel.* The results are obtained by using the methods of *integration* and *logic analysis*.

The created model is assessed by using the methods of *CBA*, *financial analysis and modeling, simulation*, *comparison* and *logic analysis*.

Conclusions are prepared by using the *method of logic analysis and generalization*.

The structure of the dissertation

The dissertation consists of an introduction, three the main parts and conclusions. Figure 0.1 provides the scheme of the dissertation structure.

The first part of the dissertation is devoted to the analysis of theoretical aspects of assessing the possibilities of PPP to optimize investments in public infrastructure. It starts with the analysis of government's role in optimization of investments in public infrastructure, an analysis of economic and financial aspects of this kind of optimization as well as factors encouraging both the public and private sectors to go into the PPP. It finishes with the formation of conception of evaluation of the private sector's possibilities to optimize investments in public infrastructure (Part 1, Section 1). The next major section analyzes the PPP as a possibility to optimize investments in public infrastructure (Part 1, Section 2): it provides the concept and definition of the PPP, analyzes and systemizes the forms of PPP, discloses its advantages and disadvantages and finally ends with an analysis of structuring of the PPP. Part 1 of the dissertation finishes with the theoretical aspects of assessing the possibilities of PPP to optimize investments in public infrastructure, where the conception of VfM assessment is defined as well as different practices and factors which increase VfM are analyzed and systemized (Part 1, Section 3).

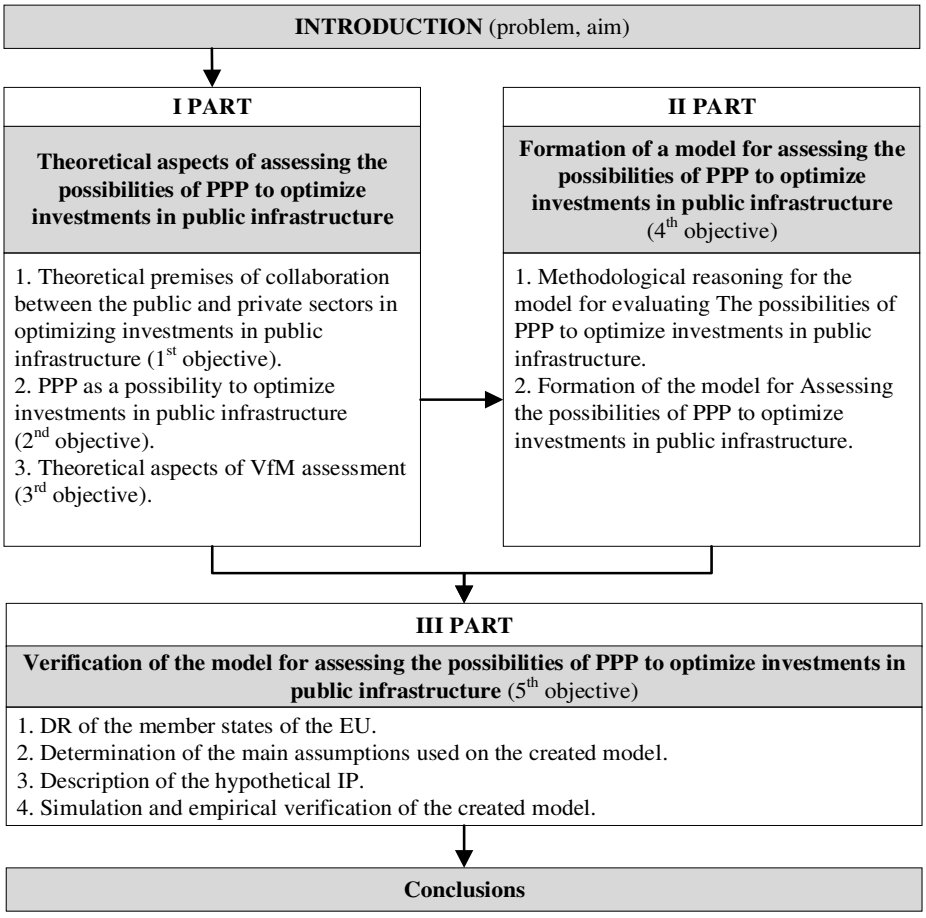

Figure 0.1. Logical structure of the dissertation (prepared by the author of this dissertation)

The second part is devoted to the development of a complex model for assessing the possibilities of PPP to optimize investments in public infrastructure. Firstly, the methodological reasoning of solutions for issues related to this assessment is provided (Part 2, Section 1), based on which the created model is presented in the second major section (Part 2, Section 2).

In the third part, the suitability of the created model to assess the possibilities of PPP to optimize investments in public infrastructure is empirically assessed. Accordingly, in the first major section the main assumptions used in the created model are determined (Part 3, Section 1). Then, the IP is described, based on which (Part 3, Section 2) the model's suitability to be applied in solving the theoretical and practical issues related to the assessment of PPP's possibilities to optimize investments in public infrastructure is verified in the second major section.

The dissertation ends with the provision of consolidated conclusions revealing the results in the achievement of dissertation's objectives.

The scientific novelty and theoretical significance of the dissertation

1. Systemizing the financial and socio-economic aspects, the theoretical premises of collaboration between the public and private sectors in optimizing investments in public infrastructure are analyzed and, based on these results, the conception of evaluation of the private sector's possibilities to optimize investments in public infrastructure is developed and theoretically reasoned;
2. The conception of the PPP as a possibility to optimize investments in public infrastructure is analyzed;
3. Integrating various approaches, the conception of VfM assessment is defined within the context of the PPP and, filling the gap in scientific literature; a methodology allowing to assess VfM for the PPA, the public sector and the users separately is developed;
4. Analyzing various approaches and methods of risk assessment, the methodology of risk assessment and allocation in the PPPs is developed;
5. The scientific field of empirical researches analyzing the tendencies of investment cost overrun in the public IPs is supplemented by providing the empirically-based PDs and their parameters which best enable to assess cost overrun risk in these IPs in the case of Lithuania;
6. Systemizing various approaches to calculation of FDR of the public sector, a methodology allowing to calculate the specific FDRs for each of the member states of the EU is developed;
7. Considering the features of PPP, criteria allowing to identify the IPs having a potential of PPP are formed;
8. Considering the identified requirements of various stakeholders, conditions allowing to optimize the option of IP's implementation with the appropriate involvement of the private sector is formulated, making it financially viable and rational to compare against the option of the public sector;

9. A methodological interface between the CBA and assessment of PPP's possibilities to optimize investments in public infrastructure is identified;
10. A complex methodology for assessing the possibilities of PPP to optimize investments in public infrastructure is developed and empirically-grounded.

Possible practical application of dissertation findings[1]

1. The results of this dissertation, i.e. the empirically-based PDs and their parameters are applied for the assessment of investment cost overrun risk for all public IPs of which capital investments exceed 300k EUR in the public sector of Lithuania;
2. The methodology of PPP indicators' ($FOPS_{max}$, $FOPS_{rtn}$, MP_{pr}) calculation developed in this dissertation as well as the formulated principles of risk assessment and allocation are applied in practice for assessing the expected public sector's obligations and payments in the public sector of Lithuania;
3. A complex integrated model for assessing the possibilities provided by the PPP to optimize investments in public infrastructure is created, allowing the developers of a public IP in Lithuania and other countries to have a practical tool to perform this task and make reasoned decisions for the most efficient way of IP's implementation;
4. The assessment of the created model's suitability to be applied in practice provides clarity of how the appropriate issues of the assessment of PPP's possibilities to optimize investments in public infrastructure could be practically solved.

Scientific approbation of the dissertation. The results of the dissertation research were published in five scientific publications and have been presented in two international scientific conferences.

Articles indexed in the Web of Science with Impact Factor:

1. Jasiukevičius, Linas; Vasiliauskaitė, Asta. (2018). The assessment of Public-Private Partnership's possibilities to optimize investments in public infrastructure. *Inžinerinė ekonomika = Engineering economics.* Kaunas University of Technology. Kaunas: ISSN 1392-2785. Vol. 29, No. 1, p. XXX.
2. Jasiukevičius, Linas; Vasiliauskaitė, Asta. (2015). Cost overrun risk assessment in the public investment projects: an empirically-grounded research. *Inžinerinė ekonomika = Engineering economics.* Kaunas University of Technology. Kaunas: KTU. ISSN 1392-2785. Vol. 26, No. 3, p. 245-254.

Articles indexed in the Web of Science without Impact Factor:

[1] From 2013 the author of this dissertation at the time of the preparing this work has also worked as a developer of CBA methodology in Lithuania as well as an expert of public-private partnership at the Central Project Management Agency, where he had a possibility to apply the research results in practice by improving the methodologies of CBA and PPP.

1. Jasiukevičius, Linas; Vasiliauskaitė Asta. (2015). Risk assessment in public investment projects: impact of empirically-grounded methodology on measured values of intangible obligations in Lithuania. Procedia social and behavioral sciences: 20th international scientific conference economics and management 2015 (ICEM-2015). Amsterdam: Elsevier. ISSN 1877-0428. 2015, vol. 213, p. 370-375. (Presented in conference Economics and Management 2015).

Publications in other international databases (articles in periodicals, collections of articles and conference proceedings):

1. Jasiukevičius, Linas; Vasiliauskaitė, Asta. (2013). The relation between economic growth and public-private partnership market development in the countries of the European Union // *Economics and management = Ekonomika ir vadyba.* Kaunas University of Technology. Kaunas: KTU. ISSN 1822-6515. 2013, No. 18 (2), p. 226-236. (Presented in conference Economics and Management 2013).
2. Jasiukevičius, Linas; Vasiliauskaitė, Asta. Formation of optimal capital structure in private-public partnership // Economics and management = Ekonomika ir vadyba. Kaunas University of Technology. Kaunas: KTU. ISSN 1822-6515. 2012, no. 17(4), p. 1275-1281.

The scope of the dissertation. The dissertation consists of lists of tables and figures, a glossary of used terms, an introduction, three main parts, conclusions, references and appendices. The dissertation contains 228 pages (excluding 35 appendices) with 26 numerical formulas, 40 figures, 19 tables and 385 references.

1. THEORETICAL ASPECTS OF ASSESSING THE POSSIBILITIES OF PPP TO OPTIMIZE INVESTMETS IN PUBLIC INFRASTRUCTURE

As an independent research field, the assessment of PPP's possibilities to optimize investments in public infrastructure begun to develop since the late 1980s under the influence of spreading neoliberal ideologies (Morales et al., 2013). Under the neoliberal critics' diagnosis of inability of the public sector alone to fill the gap of public infrastructure needed for economic development and the encouragement of the public bureaucracy to hand over the provision of public facilities and services to the private actors, the search for potential forms of the public and private sectors' collaboration as well as the assessment of their effectiveness has become relevant in practical and academic points of view (Dunn-Cavelty & Suter, 2009; Y. Zhang, 2014). VfM is a primary concept which is the basis for developing a methodology for assessing PPP's possibilities to optimize investments, i.e. it is mostly focused on the comparison of the public and private options of IP's implementation. Here emerges the necessity to apply a complex approach which would integrate all aspects important to consider and all factors required to coherently evaluate the reliability of VfM assessment and rational decision making for the most effective way to provide the public infrastructure and services. Accordingly, to achieve the aim of the research, there is a need for integrated systematic analysis of theoretical premises and aspects of assessment of PPP's possibilities to optimize investments in public infrastructure.

In this part of the dissertation the theoretical premises and incentives of collaboration between the public and private sectors are analyzed as well as PPP as the possibility to optimize investments in public infrastructure, and the theoretical aspects and problems of VfM assessment within the context of PPP.

1.1. Theoretical premises of collaboration between the public and private sectors in optimizing investments in public infrastructure

The analysis of theoretical premises of collaboration between the public and private sectors starts with the analysis of government's role in the optimization of investments in public infrastructure. The economic and financial aspects of optimizing public investments are also analyzed. In the second section, the factors encouraging the public and private sectors to collaborate are investigated. Finally, the conception of assessing the possibilities to optimize investments in public infrastructure is provided.

1.1.1. Role of government in the optimization of investments in public infrastructure

Traditionally, the governments as well as the entire public sector are responsible for providing specific services, such as health, education, justice, transport, public security and national defense, and for developing and maintaining the basic infrastructure, such as roads, ports, prisons, hospitals, libraries, schools, etc. needed for their delivery. Situations described in the economic literature as 'market failures' are one of the main reasons determining that these types of services

and infrastructure cannot be provided entirely by the private sector (Bond, 1999; Burke & Demirag, 2015; B. L. Chen et al., 2012; Devapriya, 2006; Herranz-Loncán, 2007; Link & Scott, 2001; Roll & Verbeke, 1998; Sarmento & Renneboog, 2016; Y. Zhang, 2014). Due to a lack of profitability, the private entities are not able to provide them at the quality required[2] by the PPA and quantity needed by the users. However, for various social, political and economic reasons, their provision as 'merit goods' is vital for a society where governments are responsible for the assurance of universal access to these goods and services, which, therefore, may obtain a partially or purely 'public' statue (Duran-fernandez & Santos, 2014). Without such intervention, the public infrastructure which is free of charge to society would not be built, especially when it requires enormous capital investments, such as networks of roads, railways, street lighting, electricity transmission and distribution, etc. The second reason of the above-mentioned services and infrastructure to be provided by the public sector is that they may be characterized as natural monopolies and, due to their sensitivity for public interest, require at least some public intervention. Moreover, their provision may not be efficient in the competitive market (Auriol & Picard, 2013; Bin & Quan, 2012; Evenhuis & Vickerman, 2010; Kateja, 2012; Radygin, Simachev, & Entov, 2015; Sarmento & Renneboog, 2016; Silvestre, 2012; Dimitrios a. Tsamboulas & Kapros, 2003; Urbonavicius, 2010; Yinglin Wang & Liu, 2015). The third reason for public provision of infrastructure is the existence of economy of scale in production. In this case, central and coordinated provision might be more efficient than a decentralized and uncoordinated supply by private entities (Duran-fernandez & Santos, 2014). Finally, the private sector is less interested in externalities i.e. economic growth, sustainable development, social-economic benefits etc., therefore, the intervention of the public sector is required (Agénor, 2010; M. R. Gupta & Barman, 2010; Sarmento & Renneboog, 2016).

The government authorities (GAs) have to ensure that investments in public services and infrastructure primarily would have a positive net impact on economic development and social welfare (Carmona, 2010; B. L. Chen et al., 2012; Diana, 1995; Haughwout, 2002; Macário, 2010a; Percoco, 2014; Sambrani, 2014; Zangoueinezhad & Azar, 2014). In such cases, Cost-Benefit Analysis (CBA) is the most prevalent systematic approach applied to select the socially-economically optimal alternative of IPs' implementation (Brzozowska, 2007; Toke & Lauber, 2007; Vandermeulen, Verspecht, Vermeire, Van Huylenbroeck, & Gellynck, 2011). However, beside the social-economic benefit, the public services and infrastructure should be provided in the most financially-efficient manner (Bao et al., 2014; B. L. Chen et al., 2012; de Jong et al., 2010; Diana, 1995; Gouveia & Raposo, 2012; Harada & Ogunlan, 2015; Janssen et al., 2016; Kurniawan et al., 2015; Mota & Moreira, 2015; Raipa & Kavaliauskaitė, 2008; Sarmento & Renneboog, 2016;

[2] Standards for public services and infrastructure often are not well-defined in the public sector. Moreover, the public sector itself does not always follow the conditions applied for public services provision, which at the same time are obligatory for the private entities intended to participate in public provision. This, in turn, distorts the comparative results of the public and private sectors' performance.

Shaoul, 2005; E. C. Wang, 2002). The GAs have a task and responsibility to maximize the value to the society available from the limited public resources. Considering the fact that, on the one hand, conventional provision of public infrastructure usually requires high initial investments (Evenhuis & Vickerman, 2010; Felix; Villalba-Romero & Liyanage, 2016; N. Wang, 2014), and, on the other hand, there exist financial and budgetary constraints (Alexandersson, Nash, & Preston, 2008; Benito et al., 2008; Bom & Ligthart, 2014; Daito & Gifford, 2014; Fernandes et al., 2015; Grubišić Šeba et al., 2014; Hanák & Muchová, 2015; Kellermann, 2007; Khmel & Zhao, 2015; Maskin & Tirole, 2008; Mota & Moreira, 2015; Percoco, 2014; Sarmento & Renneboog, 2016; Shaoul, 2011; Tamai, 2014; Andreas; Wibowo & Alfen, 2015; Andreas Wibowo, 2004), governments have to play an administrative role and create opportunities and conditions for private investors (Čiarnienė & Vienažindienė, 2007; de Jong et al., 2010; Huang & Chou, 2006; Khmel & Zhao, 2015; Sikka, 2015; Wojewnik-Filipkowska & Trojanowski, 2013; Y. Zhang, 2014), whose participation may potentially create a more efficient alternative to the conventional provision (Carbonara et al., 2014; Gouveia & Raposo, 2012; Grubišić Šeba et al., 2014; Hanaoka & Palapus, 2012; Janssen et al., 2016; Andreas; Wibowo & Alfen, 2015). Their participation in the development of public infrastructure can be justified only if there are reasoned arguments to expect that the private entities can optimize investments in public infrastructure, i.e. they can deliver a greater value and/or efficiencies additional to those obtainable purely from the public sector (Burke & Demirag, 2015; Grimsey & Lewis, 2005; Harada & Ogunlan, 2015; Jin & Zhang, 2011; Liu et al., 2015; Martins et al., 2011; Shaoul, 2005; N. Wang, 2014). Nevertheless, scientific literature is rich in respect of studies which present the negative experience of public sector's collaboration with the private sector beside the positive (Daito & Gifford, 2014). Therefore, decision-making regarding the ways of developing the public infrastructure requires accurate ex-ante assessment (Ball, 2011; Gouveia & Raposo, 2012; Liu et al., 2015; Moro Visconti, 2014; Poulton & Macartney, 2012; Tsamboulas et al., 2013; Tsamboulas & Kapros, 2003; Wang, 2014). While governments, despite a lack of specific knowledge and practice (Ernest Effah; Ameyaw & Chan, 2015; Khan & Mushtaq, 2009), are responsible for the accumulation of essential competence needed to make rational decisions (Ahmed & Ali, 2006; Boyer & Newcomer, 2015; Iseki & Houtman, 2012; Mota & Moreira, 2015), which, considering the possibilities of the public sector to replace infrastructure at an average rate of 1–2% per year, may affect the society for as long as 50–100 years (Roelich et al., 2015).

Growing private participation in the development of public infrastructure in respect of both the number of IPs and the value of capital investments (PPIAF, 2016) discloses a changing role of the GAs in the provision of public facilities and services to the society as well as put into question the role of government in the economic progress and efficient use of public resources (Chatterjee & Mahbub Morshed, 2011; Frischmann, 2005; Marcelin & Mathur, 2014; Sineviciene & Vasiliauskaite, 2012). In some cases, instead of being the provider, the public sector remains only the guarantor and retains the overall operational responsibility, while the provision is committed to the private sector (Bin & Quan, 2012; Galilea &

Medda, 2010; Müller & Turner, 2005; Olalekan & Hashim, 2014; Shaoul, Stafford, & Stapleton, 2012; Yin Wang, 2015). Such transfer allows the government to focus more on their strategic planning and regulation (Abednego & Ogunlana, 2006; Gordon et al., 2013; Gouveia & Raposo, 2012; Liu et al., 2015; Sarmento & Renneboog, 2016). In other words, governments as strategic investors seek to maximize social-economic benefits through investments (Esfahani & Ramírez, 2003). While, on the operational level, the private sector in a broad spectrum of possible cooperation forms with the public sector can potentially provide additional possibilities in respect of efficiency, quality and financial accessibility. However, their use also depends on the government's investment policy regarding the level of the private sector's involvement in the economic sectors, traditionally considered as a domain of the public sector (Chatterjee & Mahbub Morshed, 2011).

Over the last two decades, the policy shift towards market provision of many public goods, services and, especially, infrastructure shows an increasing relying on the private sector for the provision (Auriol & Picard, 2013; Devapriya, 2006; Janssen et al., 2016; Roehrich et al., 2014; Yin Wang, 2015). For example, between 1990 and 2014, about 7,000 PPP infrastructure IPs (two-thirds of them during the last decade) worldwide represented a total capital value of nearly US$2,543 trillion (World bank, 2016b). Moreover, the case related to private provision is much stronger in the economies characterized by a higher level of economic development, such as the UK, France, Canada, Australia, the USA, Spain, Germany, etc. (Babatunde et al., 2015; Chatterjee & Mahbub Morshed, 2011; Shaoul, 2011). These findings show a conscious choice of some countries to move towards a greater involvement of the private sector in the provision of public service and infrastructure. Moreover, right-wing governments have been more active in promoting this phenomenon (Marcelin & Mathur, 2014).

Historically, the first long-term agreements between governments and private entities for the construction and operation of public infrastructure are found in the UK in the second half of the 17th century, at the time of industrial expansion and embryonic public finances (Auriol & Picard, 2013; Parker & Hartley, 2003). After an entire century, the first similar agreements were signed in France, Spain, Italy, Belgium and Germany (Sambrani, 2014; Skietrys & Raipa, 2009). However, although the concept of using private capital to provide public goods and services have been known for several centuries, the cooperation between the public and private sectors has significantly increased across the globe only in the late 1980s (Alonso, Clifton, & Diaz-Fuentes, 2013; Babatunde et al., 2015; Dunn-Cavelty & Suter, 2009; Kateja, 2012; Lawther & Martin, 2005; Morales et al., 2013; Pauliukevičiūtė, 2010; Shaoul et al., 2012; Skietrys & Raipa, 2009; Šutavičienė, 2011b) by starting to implement neoliberal economic reforms in many countries, among which, the cases of the UK and the USA are the best known (Baker & Burdman, 1996; Clark & Root, 1999; Khadaroo, 2008; Lawther & Martin, 2005; Loh & Hu, 2014; Sikka, 2015; Yin Wang, 2015; N. Wang, 2014; Whiting, 2013). Through various neoliberal political and economic practices, collectively referred to as the Washington Consensus (Loh & Hu, 2014; Marangos, 2009; Sheppard, Leitner, & Marangos, 2009), (reviewed by Ioris, 2012; Loh & Hu, 2014; Morales et

al., 2013; Shaoul, 2011; Shaoul et al., 2012; Y. Zhang, 2014), these countries have privatized, liberalized and deregulated the markets previously exclusively preserved by the public sector. This New Right ideological movement based on the concept that ideas and practices used in the private sector can also be successfully applied in the public sector, and codified under the name of the New Public Management (NPM), encouraged the adoption of business principles and management techniques from the private sector into the public sector (Acerete, Stafford, & Stapleton, 2011; Alonso et al., 2013; Bezes et al., 2012; Čiarnienė & Vienažindienė, 2007; English & Guthrie, 2003; Hood, 1995; Matei & Antonie, 2014; Matei & Chesaru, 2014; Newberry, 2013; Raipa & Kavaliauskaitė, 2008; Shaoul et al., 2012; Silvestre, 2012) as well as increased the involvement of the private sector in managing and delivering public infrastructure and services. This policy shift towards the private provision, in turn, resulted in a decrease of state intervention in many economic sectors and caused a reduction of the scale and scope of the public sector in general (Savas, 1999; Shaoul et al., 2012).

However, the allowance for private entities to own or participate in the management, construction and maintenance of major infrastructure through various forms of partnerships between the public and private entities have not reduced the responsibility of governments in ensuring and maximizing opportunities for entrepreneurship, innovation and efficiency in the public sector (Hellowell, 2013; Kurniawan et al., 2015; Loh & Hu, 2014; Morales et al., 2013; Sarmento & Renneboog, 2016; Y. Zhang, 2014). It rather highlighted the role of governments in the adoption of the private sector's practices and rationalities in the public sector. Previously, the governments exercised coordination and steering through hierarchy, bureaucracy and detailed regulation. While under a paradigm of NPM, they are focused on results (A. Matei & Antonie, 2014; Scupola & Zanfei, 2016), and governance is created through networks based on interdependence, negotiation and trust among a number of public and private actors (Shaoul et al., 2012; Silvestre, 2012). The adoption of the private sector's mentalities and practices gradually influenced the public servants increasingly to think and manage like business entrepreneurs (Morales et al., 2013).

However, the increasing private participation in the provision of public infrastructure and services also increasingly challenges governments to overcome the specific issue known as the principal-agent or agency problem (Benito et al., 2008; Čiarnienė & Vienažindienė, 2007; Gordon et al., 2013; Guilding, Warnken, Ardill, & Fredline, 2005; Keser & Willinger, 2007; Macário, 2010b; Müller & Turner, 2005; Poulton & Macartney, 2012; Saam, 2007; Shrestha, Chan, Aibinu, & Chen, 2016; Yinglin Wang & Liu, 2015; Wright, Mukherji, & Kroll, 2001). It occurs because of different natures of the public and private entities. The GAs ('the principals') primarily seek social welfare and VfM. While, the main purpose of the private entities ('the agents') is business sustainability and profit maximization. This determines that the principal-agent relations between the public and private sectors can exist if the balance between the interests of both parties is achieved (Evenhuis & Vickerman, 2010; Hwang et al., 2013; Yu & Lam, 2013; Khmel & Zhao, 2015; Kurniawan et al., 2015; Lehtiranta, 2014). However, it is the responsibility of the

GAs to select the most suitable private entities and ensure their performance within the public's quality requirements (Carmona, 2010; Harada & Ogunlan, 2015; Macário, 2010a; Xu et al., 2012) as well as to get the best VfM to the public sector in comparison with CP (Liu et al., 2015; Wang, 2014).

However, according to Fernandes et al. (2015), Guilding et al. (2005), Müller & Turner (2005), Stasiukynas (2011), Wright et al. (2001), Zitron (2006), these tasks are not without problems. The first one known as 'the moral hazard problem' can appear when the private entities, which are engaged to provide some services on the PPAs' behalf and delegated to make some decisions, do not act in the best interests of the GAs. They do what is best for themselves and do what is best for the GAs only if their interests are aligned instead. The second one, referred as 'the adverse selection problem', arises due to the inability of the GAs to acquire all information about the private entities and information which is available to or possessed by the private entities, as well as monitor their actions perfectly. Theories of transaction cost and agency state that governments as a customer get into a worse situation than engaged agents due to information asymmetry, uncertainty and other environmental and human factors (Stasiukynas, 2011). Therefore, the GAs cannot fully know all arguments for decisions made by the private entities and be totally certain whether these decisions are right choices on behalf of the public sector. This information asymmetry can determine the government entities as being unable to select the most appropriate private entities for specific tasks and monitor results of their performance perfectly which, in turn, can cause inefficiencies regarding the provision of public infrastructure and services and create potential for mistrust and morality issues (Benito et al., 2008; Evenhuis & Vickerman, 2010; Saam, 2007; Yinglin Wang & Liu, 2015; Wright et al., 2001).

Agency theory suggests solving these issues by aligning the interests of the two parties through contracts designed so that the agreed conditions would encourage positive incentives from the private party to perform consistently with the social goals and better VfM for the public sector (Evenhuis & Vickerman, 2010; Gordon et al., 2013; Macário, 2010b; Moro Visconti, 2014; Müller & Turner, 2005). Saam (2007) provides a review of possible solutions for the agency problem which include various decisions related to the procedure of the private entity's selection, determination of partnership form as well as payment and compensation mechanism, and monitoring. Their complex application allows reducing the private entities' hidden characteristics and intensions as well as hidden information and knowledge they possess. However, this also makes the ex-ante VfM assessment a complicated task. Nevertheless, there is a unanimous agreement (De Clerck & Demeulemeester, 2015) that in general the GAs are responsible for overcoming the inefficiencies through a well-designed tender procedure, the development of a contract that contains adequate incentives, strict monitoring and enforcement of the provisions in the contract. However, the efficient implementation of these aspects remains a relevant issue both in academic and political debates.

There are many elements of the contract which need to be properly determined and relevant factors to be considered by governments to create conditions which would allow both getting better VfM to the public sector and making the contract

attractive for the private entities to participate and herewith encouraging their appropriate incentives within social interest in provision of public infrastructure and services (Janssen et al., 2016; Ng et al., 2012; Song et al., 2015; Andreas; Wibowo & Alfen, 2015). This primarily requires a well-established legal/regulatory framework which could effectively regulate the field of public and private sectors' contractual relations and facilitate the contracting of partnerships with private entities (Carranza et al., 2014; Clark & Root, 1999; Galilea & Medda, 2010; Janssen et al., 2016; Mota & Moreira, 2015; Mu et al., 2011; Savas, 1999; Šutavičienė, 2011a; Yin Wang, 2015; Andreas; Wibowo & Alfen, 2015). However, the decisions for IPs' implementation under long-term contracts with private entities and the finding of mutually acceptable contractual agreements usually have to be made on a case-by-case basis. The reason is individual risk allocation between the public and private parties in every IP the optimization of which, as disclosed by Abednego & Ogunlana, 2006; Chang, 2014; Chou et al., 2012; Jin & Zhang, 2011; Ng & Loosemore, 2007; Zangoueinezhad & Azar, 2014 is challenging and demanding. Therefore, GAs are responsible for the development of effective risk allocation and mitigation strategies as well as application of models, tools and techniques enabling to achieve proper contractual arrangements (Carbonara et al., 2014; Hwang et al., 2013; Kurniawan et al., 2015; Y. Zhang, 2014). Moreover, considering the goals of both parties to maximize their economic position, explained by preference theory (Stasiukynas, 2011), GAs' role in negotiation is also important, where the balance of interests between the parties as well as the best VfM for the public sector could be achieved (Fernandes et al., 2015; Ke et al., 2010; Sarmento & Renneboog, 2016; L. Shen et al., 2007; Thomas Ng et al., 2007).

A number of studies (Gordon et al., 2013; Hwang et al., 2013; Ng et al., 2012; Song et al., 2015; Yinglin Wang & Liu, 2015; Andreas; Wibowo & Alfen, 2015) have been conducted to identify the CSFs for successful cooperation between the public and private entities under long-term agreements, which refer to the key areas of activity where favorable results are necessary for the success of such contracts and which have to be assessed in advance. Herewith, scientists unanimously state that the GAs as a procurer are responsible for their identification as well as, considering them, play a leading role in formulating and building effective partnerships with the private entities. This allows stating that the more efforts governments put on creating a favorable environment for alternative ways of implementing investments, the higher potential there is to optimize investments in public infrastructure by involving the private entities. However, from the perspective of the public sector, the optimization of investments in public infrastructure can be analyzed from the perspectives of the social-economic and financial aspects.

1.1.1.1. Economic aspects of optimizing investments in public infrastructure

The economic aspects of optimizing investments in public infrastructure reveal mostly in the context of economic performance in respect of its productivity and efficiency. Mamatzakis (2003) defines productivity growth as the part of output growth that cannot be explained by an increase in the use of inputs. It is attributed to the development of technology, scale effects and increase in the efficiency of

resource used. There is a substantial amount of literature on economic growth, where it is explained by public infrastructural expenditure. However, scientific discussions disclose (Mamatzakis, 2003; E. C. Wang, 2002) that the effect of public infrastructural investments on economic growth is still controversial and, therefore, requires more extensive analysis in order to analyze the economic aspects of optimizing investments in public infrastructure.

Infrastructure as an investment object is easier to recognize than define. According to Frischmann (2005), the term 'Infrastructure' generally conjures up the notion of physical resource systems made by humans for public consumption. While investments in infrastructure are thought to provide basic services to the industry and households. It is a key input into the economy, which is crucial for its operation and growth. However, according to Grimsey & Lewis (2002) and Zangoueinezhad & Azar (2014), what is considered as 'basic', 'key' and 'crucial' varies between countries and depends on time, i.e. coal mining and steel production were considered as essential infrastructure several decades ago (Betz, Partridge, Farren, & Lobao, 2015), whereas the broadband network is considered as necessary infrastructure in the digital era (Czernich, Falck, Kretschmer, & Woessmann, 2011). Grimsey & Lewis (2002) provide the most commonly found classification of infrastructure, which is based on different economic activities:

- Transport, such as highway systems, railways, airline systems, and ports;
- Communication, such as telephone and broadband networks and postal services;
- Energy, such as power generation, transfer and supply;
- Water, such as sewerage, waste water treatment and water supply;
- Health, such as hospitals and clinics;
- Social infrastructure, such as prisons, courts, museums, schools, government accommodation, etc.

Literature could also provide a more detailed classification, however, typically, this so-called traditional infrastructure can be divided into two broad categories: economic infrastructure and social infrastructure, depending on whether it is gathered revenues from direct users for services provided in the appropriate infrastructure, what, in turn, makes a business activity feasible or not, respectively (Ng & Loosemore, 2007). The economic infrastructure includes drainage systems, sewage treatment plants, telecommunications networks, toll roads, bridges, railways, air transport facilities, etc. The social infrastructure includes assets that usually accommodate social services, such as education, prisons, justice, library, public safety, health, etc.

A distinction can also be made between 'hard' infrastructure, which is obvious and involves the provision of physical infrastructure, such as buildings, roads, bridges etc. and 'soft' infrastructure, involving the provision of services, either for economic infrastructure e.g. street cleaning, utility network repairing, catering, security, etc. or for social infrastructure e.g. education, health, social, public security services, etc. (Fung, Garcia-Herrero, Iizaka, & Siu, 2005; Hellowell, 2013; Portugal-Perez & Wilson, 2012).

Despite various classifications, investments in public infrastructure share a number of common characteristics (Grimsey & Lewis, 2002):

- Duration – infrastructure is long-lived and has a long gestation process;
- Illiquid – the lumpiness and indivisibility of infrastructure IPs makes it being limited in the secondary market;
- Capital intensive – infrastructural IPs are large in scale and highly geared (Sanderson, 2012);
- Valuation – IPs are difficult to evaluate because of taxation, pricing rules, embedded options and guarantees.

The last characteristic is associated with the issue which attracts the most interests of scientists, since public infrastructure is viewed as an input in economy that can reduce private sector's cost of production. Many studies have attempted to measure the productivity of public infrastructure, mostly adopting a methodology based on one of three main approaches: The Cobb-Douglas production function approach, the cost function approach, and the causality approach. Most of them mostly focused on the transport sector, have found high returns on infrastructure investments, or emphasize an important role of infrastructure in ensuring sustainable growth of local economy (Agbelie, 2014; Agénor, 2010; Anwar, 2006; Berawi et al., 2014; Bin & Quan, 2012; Bom & Ligthart, 2014; Chandra & Thompson, 2000; Duran-fernandez & Santos, 2014; Glomm & Ravikumar, 1999; Gupta & Barman, 2010; Heijdra & Meijdam, 2002; Hickford et al., 2015; Hosoya, 2014; Mamatzakis, 2007; Percoco, 2014; Pradhan & Bagchi, 2013; Sambrani, 2014; Shi & Huang, 2014; Zawawi et al., 2014). Melo et al. (2013) also found that the productivity effect of transport infrastructure can vary across the main industry groups. It tends to be higher in the US economy than in European countries, and are higher for roads compared to other modes of transport.

However, the robustness of the results has been questioned in other empirical studies and surveys. Some findings claim that the effect of public infrastructure on the economic growth is statistically insignificant (Herranz-Loncán, 2007; Mamatzakis, 2003) or, among those that are significant, are more negative than positive, both in the short- and long-run periods (Crihfield & Panggabean, 1995; Moreno et al., 2002), or state about the absence of direct effects on outputs (Holtz-Eakin & Lovely, 1996). Rioja (2003) presents empirical results supporting the positive effects of public maintenance's expenditures but adverse effects of capital expenditure on GDP in developing countries. He concluded that more attention should be paid to the evaluation of effects of maintenance of public infrastructure on GDP growth.

Additionally, scientists such as Esfahani & Ramírez (2003), Pradhan & Bagchi (2013), Wang (2002) concern with the issue of how to determine the direction of causality between infrastructure investments and aggregate output. They argue that public infrastructure may affect productivity and output, while economic growth can also shape the demand and supply of infrastructure, which is likely to cause an upward bias in the estimated returns to infrastructure.

Although the above-reviewed results are controversial, it is fair to state that scientists, especially in the later studies, generally support the notion that public

capital is productive and, as an additional factor alongside the labor and private investments, is a must for the economic development. When public infrastructure is planned and maintained well, it plays a vital role in supporting a high standard of living, encouraging private investments and facilitating commerce and trade, enhancing the attractiveness and competitiveness of economy, thereby it extends a nation's global wealth. Accordingly, this is one of the main arguments for incentive of such international economic bodies as the World Bank (WB), the European Investment Bank, the EU, etc. to provide loans on easy terms or grants, respectively, for infrastructure policy financing.

According to Olalekan & Hashim (2014), the cost of maintaining and expanding the existing public infrastructures in the developed countries is about 7% of their GDP. While public spending in the developing countries to deliver infrastructural facilities is about 3%. Bom & Ligthart (2014) state that most of the OECD countries currently operate public investment ratios below 5%. This indicates that the developing countries need to increase their funding on infrastructure so that those economies could improve and achieve higher economic development. However, the developed countries also face serious challenges to ensure high-quality infrastructure, especially under the conditions of economic and financial crisis (Dunn-Cavelty & Suter, 2009; Hellowell, 2013; Martins et al., 2011; Felix; Villalba-Romero & Liyanage, 2016; Whiting, 2013). This discloses the inability of governments to satisfy all infrastructural needs, which, in turn, requires optimizing public investments in a way that would allow achieving optimal combination of the whole costs and social-economic benefits to meet the society's requirements.

Historically, CBA is the most prevalent method for assessing and comparing direct and indirect social-economic benefits and the costs of possible alternatives of IP's implementation, and allows to select the optimal one as well as to appraise the potential investment decisions (Pradhan & Bagchi, 2013). Economic performance indicators such as Economic Net Present Value (ENPV) and Economic Rate of Return (ERR) are the main indicators allowing comparability and ranking of competing IPs or alternatives of IP (European Commission, 2014b). The economic benefits and costs ratio (EBCR) (CPVA, 2014a) is also used. The option with the highest positive ENPV[3] and other above-mentioned relative indicators is the most beneficial to implement from the social-economic perspective, accordingly.

The above-mentioned arguments allow stating that from the economic perspective, the optimization of investments in infrastructure can be distinguished into the strategic and operational levels. The former, based on econometric calculation, focus on the selection of the most productive sectors for investment and formation of sectorial investment portfolios, accordingly. While the later refer to social-economic VfM maximization at the project level. Considering the aim of the research, the operational level of investments' optimization in infrastructure is mostly considered further in the dissertation.

[3] Accordingly, ENPV is rational to use when the scope of comparative options is the same, otherwise EBCR as a comparative indicator should be more prioritized for the assessment.

1.1.1.2. Financial aspects of optimizing investments in public infrastructure

The financial aspects of optimizing investments in public infrastructure reveal mostly through the requirement to efficiently use public financial resources available for building and maintaining infrastructure. Here, efficiency refers to the ability to implement investments without wasting materials, energy, efforts, money and time (Serrador & Rodney Turner, 2014; Sundqvist, Backlund, & Chronéer, 2014). This dissertation mostly focuses on such financial aspects as cost-efficiency, optimization of capital structure and risk allocation.

According to Hanák & Muchová (2015), efficient use of public resources is one of the main challenges related to public investment. This concerns the entire life cycle of infrastructure, starting from the preparation of design documentation to demolition of infrastructure at the end of the investments' lifetime. Economic theory suggests that the bundling of IP's components may provide cost-efficiency. Therefore, the efficiency of investments should be considered from the perspective of life-cycle costs, i.e. all costs related to the design, construction, operation and maintenance need to be considered, evaluated and compared to other options so that a solution characterized by the lowest possible costs could be found (Carmona, 2010; Cruz & Marques, 2013; Daito & Gifford, 2014; Heralova, 2014; Iseki & Houtman, 2012; Maskin & Tirole, 2008; Mota & Moreira, 2015; Sarmento & Renneboog, 2016; Li Yin Shen et al., 2006).

However, according to Hanák & Muchová (2015), and Heralova (2014), the use of Life Cycle Costing (LCC) in the construction sector is rather rare in the public sector of many countries. The PPAs often select the winning bidder simply based on the lowest bidding price rather than on the basis of the most economically beneficial tender. Even in the case of multi-criteria evaluation, which enables to deal with multiple dimensions of evaluation aspects (Tamosaitiene, Zavadskas, & Turskis, 2013; Turskis, Zavadskas, & Peldschus, 2009; Zavadskas, Turskis, Ustinovichius, & Shevchenko, 2010), the criterion of investment costs often weight double all remaining criteria together, e.g. costs related to operation and maintenance, and, therefore, have a very significant influence in most infrastructure IPs' tenders regarding their overall efficiency. This results in lower possibilities to minimize life cycle costs of the IP. This especially concerns the concessions and other long-term contractual agreements between the PPAs and private entities, whose costs and benefits can be rationally evaluated against CP as a form of public services' provision, only if the life cycle approach is applied (Carmona, 2010; Daito & Gifford, 2014; de Jong et al., 2010; Wang, 2014; Zangoueinezhad & Azar, 2014). Therefore, the application of LLC approach is one of the most important aspects of cost optimization. However, it is also important to recognize that literature still shows a lack of empirically-grounded evidence of cost savings from bundling of IP tasks, when they are transferred to the private entities[4].

[4] According to Daito & Gifford (2014), data are limited mostly due to two reasons: their long concession durations, and proprietary nature of project data that are necessary for conducting such analysis.

Since the private sector participates in the development of public infrastructure, the optimization of IP's costs requires to develop conditions encouraging the right incentives from the private entities to perform within cost-efficiency goals. There are many dimensions which revolve around appropriate incentives. However, from the financial perspective, scientific literature mainly emphasizes two incentive elements: performance payments or rewards, and risk allocation.

Literature shows (Evenhuis & Vickerman, 2010; Gordon et al., 2013; Parker & Hartley, 2003; Saam, 2007; Felix; Villalba-Romero & Liyanage, 2016; Yinglin Wang & Liu, 2015) that the incentive payments and bonuses or their opposites, such as penalties and abatements, are especially effective and better than fixed payment schemes to ensure good performance in terms of outputs, if they are directly linked to measurable indicators (e.g. on-time performance, operating cost efficiencies; service frequency and reliability, etc.) that are likely to lead to the desired results of services. On the other hand, inputs such as increased spending or outputs such as more trains and buses, by themselves, are not desirable. Therefore, the details of incentives in every IP must be carefully worked out and defined by adequate specific indicators; otherwise, if poorly designed, they can lead to substandard outcomes and, herewith, a failure to reach optimal costs (Martins et al., 2011; N. Wang, 2014). Moreover, beside a complex of conceptually sound indicators, a robust process for measuring whether outcome targets are being met is vital, as well as an adequate system for reporting results in a timely manner and to the parties most interested in optimal performance. Typically, this includes the users of infrastructure or service and the public authorities which directly or indirectly are financing IP's implementation (Gordon et al., 2013).

Other incentive element is risk allocation, which also is crucial for IP's cost optimization (Chou et al., 2012; Jin & Zhang, 2011; Ng & Loosemore, 2007; Zangoueinezhad & Azar, 2014). Since it is considered as the third stage in risk management (after risk identification and risk analysis and assessment) (Fischer et al., 2010; Hwang et al., 2013), obviously risk allocation is a complex task which includes a number of aspects from previous stages; therefore, according to Chang (2014), Jin & Zhang (2011), Medda (2007), Ng & Loosemore (2007), Parker & Hartley (2003), Yin Wang (2015), it is challenging, demanding and one of the most pivotal issues in the complex procurement of infrastructure and services. However, appropriate risk allocation is also recognized as being critical to a successful long-term contractual relationship between the PPAs and private entities (Gupta et al., 2013; Hwang et al., 2013; Yin Wang, 2015). Accordingly, literature is rich in papers addressing risk allocation. However, since more attention is paid to uncertainty and risk in other parts of this dissertation, only key findings are presented here. They allow stating that the entity from which the risk emanates and which is thus best able to control it may not always be able to control risk in the most efficient way and at the lowest costs (Ke et al., 2010). Therefore, a principle to allocate each of the risks to the party best able to manage it at least costs is commonly accepted (Alexandersson et al., 2008; Daito & Gifford, 2014; Demirag, Khadaroo, Stapleton, & Stevenson, 2011; Desgrées du Lou, 2012; Engel, Fischer, & Galetovic, 2011; Gordon et al., 2013; Hwang et al., 2013; Iseki & Houtman, 2012; Jin & Zhang,

2011; Sarmento & Renneboog, 2016; Wang, 2014). In other words, the goal of optimal risk allocation is not to transfer as many risks as possible to the private sector, but to find a solution which would allow minimizing life cycle costs of IP implementation to the entities of both the public and private sectors, because all costs have to be covered by the same general public or direct users in the end. Additionally, the ability to manage appropriate risk depends on how much of information about the risk is held by the party: the more information it holds, the better abilities it has to manage it. In the case of symmetric information, risks should be shared between the PPA and the private entity depending on their relative risk-aversion or on their portfolio of tasks.

Equally important financial aspects related to risk allocation/sharing is the optimization of capital structure, which also effects the efficiency of public investments and mainly concerns financial sources, ratios of different types of funds and the timeframe of fund usage (Cruz & Marques, 2013; Gasiorowski & Moszoro, 2008; Khmel & Zhao, 2015; Moro Visconti, 2014; Mu et al., 2011; Short, Keasey, & Duxbury, 2002; Andreas Wibowo et al., 2012). There are three general categories of funds used in financing public infrastructure: public funds, debt and equity. Public funds are provided mostly in a form of grants by the central and regional governments. Debts can come from state-owned or commercial banks, while equity is mostly pure private capital from private entities. Besides, in some special cases, such as in the less-developed countries, it can also be funds available from international lenders, such as loans from the WB or regional development banks. In some countries, as in a case of the EU, there are direct financial contributions available in the form of subsidies. There is also an alternative to finance IPs by issuing government or project bonds, as well as many variations of sophisticated financing instruments can be used. Each of these potential financial sources has its own financing costs and appropriate features, and the optimal capital structure has to be formed considering them. This suggests that to optimize capital structure, many factors should be evaluated when choosing a source of funds and developing the financial strategy, allowing to raise the necessary funds for the IP's implementation by minimizing the costs of capital.

However, money usually comes in along with the development of project life cycle, therefore the target capital structure of the IPs can change over time. Accordingly, the optimization of capital structure includes the time factor i.e. when appropriate money has to come in (Khmel & Zhao, 2015; Mu et al., 2011). For example, in the construction period, the IP may be first financed with loans, the interest rate of which is typically higher than the interest of loans got in the operation period. Therefore, after completing the construction period, refinancing can be rational. This illustrates that the optimal capital structuring is a complex continuous exercise requiring to assess various available financing schemes. Moreover, Wojewnik-Filipkowska & Trojanowski (2013) conclude that the choice of an appropriate financing model is one of the key issues with public investment.

Since IPs are faced with demand-related uncertainties, risk allocation/sharing cannot be rational without the assessment of requirements for financial assistance in the form of guarantees, subsidies and other forms of aid the governments can offer

to enhance IPs' financial viability and attractiveness for the private sector (Chen et al., 2012; Hanaoka & Palapus, 2012; Huang & Chou, 2006; Khmel & Zhao, 2015; Kokkaew & Wipulanusat, 2014; Roll & Verbeke, 1998; Shaoul et al., 2012; Andreas Wibowo, 2004). Also, in the case of revenue gathered from direct users, it is not rational to save public interest without determining of the excess revenue sharing ratio (Yinglin Wang & Liu, 2015). Typically, to deal with demand risk, governments consider the provision of two types of guarantees: demand or revenue guarantee (RG) and loan repayment guarantee (LRG). Asao et al. (2013) describe the RG as consisting of two variables: the trigger variable and the compensation mode. They define the trigger variable as the state which initiates the guarantee. When a trigger variable exceeds a predetermined minimum threshold, the guarantee is activated and the compensation from the government is carried out. The trigger variable can be classified into three types: annual revenue, cumulative revenue, and profits/internal rate of return. The compensation mode is defined as the manner of compensating a private entity when required (e.g. a defined tariff is not high enough to make the IP financially viable from the perspective of the private entities). This compensation mode can also be classified into three types: payment/subsidies, toll, and contract period extension. Theoretically, the use of both variables allows getting nine different combinations from which the government can choose the most appropriate depending on the requirements. However, according to the above-mentioned scientists, the combinations of payment-based annual revenue guarantee (PARG) and the period-extension-based cumulative revenue guarantee (PCRG) are the most widely adopted in practice. They concluded that, since payments are the main issue under strict budget constraints, the PCRG, as not requiring paying any monetary compensation from the government, is usually preferred. However, the optimal solution depends on the government's return-risk preference. It is also important to consider that, due to research limitation, these findings are not robust and require further researches. The lower are the possibilities to extend the period (e.g. a maximum allowed length of period in long-term agreement between the private and public entities can be determined by law), the more PARG becomes the optimal option to attract private investments.

LRG allows making an IP viable from the perspective of financiers, whose cost of financing is lower than private capital, but who also have their own expectations within the IPs (Khmel & Zhao, 2015; Kurniawan et al., 2015; Zhang, 2014). Typically, this includes the insurance of repayment of interest and principal amount before the agreement period between the public and private parties ends, which, in turn, also determines the final characteristics, content, and payment mechanisms of IPs (Shaoul et al., 2012).

Since the government provides investors with certain RG to reduce the market risk taken by them, considering the same principle that benefits one receives should be equal to the risks taken, governments have the right to share any excess revenue the investors gain equal to the difference between the actual revenue gained by the investors and the cap of the expected earnings. Yinglin Wang & Liu (2015) analyzed the factors allowing the PPA to determine the optimal sharing ratio of excess revenue. Regarding the behavioral theories which suggest that the excess revenue

sharing ratio influences the behavior of investors whose efforts to increase the efficiency of IP depends on their belief about the fairness of the distribution ratio. The afore-mentioned scientists concluded that the optimal excess revenue sharing ratio is related to the fairness preferences and the effort cost of the investors. The higher fairness preferences are, the lower ratio is considered by the private entity as satisfying to put efforts, described by the cost function, for efficiency. However, considering the psychological factor, the excess revenue of the investors cannot be lower than the amount which the government receives, since the satisfaction and investment enthusiasm of the investors has to be ensured. On the other hand, the PPA as a representative of the public sector has to prioritize maximizing public utility while determining the ratio. Therefore, the determination of optimal allocation of excess revenue has to be based on the fairness preferences of the investors as well as their effort costs to ensure investors are willing to put high efforts, while also maximizing public interest. This requires detailed information about the investors' fairness preferences and effort costs, and considering the earlier-mentioned P-A problem, it obviously is not an easy task in practice.

Beside the above-mentioned guarantees, the following forms of guarantees offered by governments or their representatives are also found in literature:

- Restrictive competition, which makes the investor perform in a limited form of monopoly with all the following benefits (Bin & Quan, 2012; Martins et al., 2011; Sarmento & Renneboog, 2016; Silvestre, 2012; Zitron, 2006);
- Price adjustment, which makes the IP viable in terms of financial viability and profitability (Hanák & Muchová, 2015; Qiu & Wang, 2011; Xu et al., 2012);
- Exchange rate and interest rate, which reduce uncertainty related to the costs of currency exchange and interest rate (Du & Li, 2008; Hanaoka & Palapus, 2012);
- Tax relief, which, at least temporarily, exempts the investor from taxation and, therefore, results in cost reduction (B. L. Chen et al., 2012);
- Land lease, which means the allotment of land for the implementation of IP under preferential terms (Chen et al., 2012; Yinglin Wang & Liu, 2015), etc.;

However, all of these guarantees are primarily designed not for cost-efficiency, but to increase the investors' willingness to invest as well as enhance credit worthiness of the IP facing high revenue risks (Roll & Verbeke, 1998). Therefore, since they are not without costs to the public sector and society, the provision of these guarantees always has to be assessed considering the VfM approach.

The analysis of all the above-mentioned financial aspects allows concluding that the optimization of investments in public infrastructure is focused on the total cost-efficiency including three main aspects: determination of optimal capital structure, choice of alternative of IP's implementation characterized by minimal life-cycle costs, and optimal sharing/allocation of risks between the public and private

parties. The later one, through the appropriate incentives, enables the PPA to maximize public interests.

The private sector can significantly contribute to the efficiency of the objectives. Therefore, the factors stimulating collaboration between the public and private sectors are more extensively analyzed in the following part of this dissertation.

1.1.2. Factors encouraging collaboration between the public and private sectors

Considering the existing phenomenon of collaboration between the public and private sectors, it is relevant to analyze the factors encouraging these two parties to collaborate. The analysis is divided into two sections: the first one is intended to analyze the factors from the perspective of the public sector, while the second one from the perspective of the private sector.

1.1.2.1. Factors encouraging the public sector to go into partnership with the private sector

Historically, the provision of infrastructure has been the government's monopoly. But with the problems of high re-investment costs to replace or modernize the ageing infrastructure which result in an increasing gap between a growing demand for public services and infrastructure and resources available for government to finance it, private investments have emerged as a preferred mode of financing public infrastructure. Many scientists (de Jong et al., 2010; Giedraitytė & Raipa, 2012; Grubišić Šeba et al., 2014; Gudelis & Rozenbergaitė, 2004; Mota & Moreira, 2015; Olalekan & Hashim, 2014; Percoco, 2014; Sambrani, 2014; Wojewnik-Filipkowska & Trojanowski, 2013; Zangoueinezhad & Azar, 2014) emphasize a shortage of public funds to address the infrastructural needs and unanimously state that it is highly difficult and often impossible by governments to bring together all the infrastructure elements depending on their resources. In such cases, borrowing is often seen as one of the easiest methods for governments to cover the budget deficit and collect the necessary financing needed for the development of public infrastructure. However, these attempts cannot be seen as separate from the state fiscal and monetary policy (Karazijiene, 2009). Therefore, since the debt level is growing in many countries, borrowing for public investments is becoming a serious issue, especially in countries where the level of budget deficit and borrowing is restricted by artificial rules e.g. SGP in the EU[5] (European Commission, 2014c). A survey combining the afore-mentioned fiscal constraints and publicly available local budgetary data revealed that the room for budgetary capital investments is rather small in a significant part of the EU countries. To look

[5] The EU Treaty defines an excessive budget deficit as one greater than 3% of GDP. Public debt is considered excessive under the Treaty if it exceeds 60% of GDP without diminishing at an adequate rate (defined as a decrease of the excess debt by 5% per year on average over three years). Available on: http://ec.europa.eu/economy_finance/economic_governance/sgp/index_en.htm

further, there are unexceptional cases when cities and municipalities cannot even cover their current expenditures with regular public revenues collected from taxes and administrative fees[6]. Therefore, the lack of budgetary funds is the predominant reason for the involvement of the private sector in the provision of public infrastructure. The private sector can provide access to substantial capital and optimal financial structuring, and, in turn, can speed up the necessary investments.

Another highly important motivation to increase the use of private entities is the expectation of LCC savings in delivering infrastructure and services, since private participation is able to improve efficiency through the introduction of incentives to reduce wasteful costs and collect revenues. Although some studies claim that there is no significant difference between public and private investments regarding efficiency (Daito & Gifford, 2014), most of scientists (Čiarnienė & Vienažindienė, 2005; Kateja, 2012; Mota & Moreira, 2015) state that private participation can provide higher efficiency and substantial welfare gains, i.e. better VFM.

Besides a lack of sufficient financial resources and objectives to increase the use of their efficiency, there are also plenty of non-financial factors encouraging the private sector's involvement in the provision of public infrastructure. Among these, there is the lack of the capacity in the public sector in respect of both quantity and quality of manpower to deliver a vast amount of infrastructure (Sambrani, 2014). Private entities coming to the partnership, beside the additional workforce, can bring many other motivations to collaborate, described by Desgrées du Lou (2012), Giedraitytė & Raipa (2012), Mu et al. (2011), Xu et al. (2012), Zangoueinezhad & Azar (2014), such as specific expertise and experience; they can provide creativity and appropriate technological innovation, which enhance the government's abilities to maximize added-value of the IP, herewith reducing the risks borne by the government, since a part of the risks, e.g. construction, availability, technological, management, financing etc. can be transferred to the private entities.

The above-mentioned factors allow summarizing that the spectrum of reasons to collaborate with the private sector is very wide. However, without denying the importance of other factors, financial ones, such as the possibility to get additional financing and achieve higher LCC efficiency, are predominant in literature for the involvement of the private sector in the provision of public infrastructure.

1.1.2.2. Factors encouraging private subjects to participate in partnerships with the public sector

Scientific literature on the factors encouraging private subjects to participate in long-term contractual relationships with the public sector in the development of public infrastructure is scarce and, in this regard, disclosing an important, but, nonetheless, only a supporting role of the private entities in the decision to launch a program of collaboration between the public and private entities. Therefore, the factors related with the incentive of the private entities to participate in such

[6] There are basically two mechanisms for funding the development of public infrastructure: public budget that eventually is supported by tax payers, and direct charges to users (Felix; Villalba-Romero & Liyanage, 2016).

relationships can be analyzed more from the perspective of interest of general business rather than from something specific arising from these relationships.

Accordingly, since the shift of investment policy towards private provision has opened the market for the private capital to participate in sectors traditionally considered as a domain of the public sector, it provided private actors with an enlarged market. Normally, the private entities utilize their professional skills and competence, selling them at a profit. Therefore, the enhanced opportunities to collaborate with the public sector also provide private entities with more possibilities to make a profit.

Moreover, considering the above-mentioned guarantees provided by the governments to encourage incentives of the private entities to participate in the provision of public infrastructure, long-term contractual relationships with the public sector can be considered as relatively less-risky investments from the perspective of the private sector. They often provide a long-term return, while most risks can be sub-contracted (Mu et al., 2011). In contrast to the conventional business IPs, here the private entities are exposed to market risks only to a limited extent (e.g., governments can ensure a part of revenue by purchasing a predetermined quantity of services or award the private entities with an exceptional right to provide monopoly services). Moreover, the demand for public infrastructure and services is usually quite stable, while the scope of IPs can be significantly more extensive than in the case of commercial IPs. The public sector also has higher credit rating due to lower credit risk. Therefore, these investments are especially attractive for those investors who are focused on investments emphasized by relatively lower profitability but stable revenue stream over many years.

In summary, the main incentives of the private entities to participate in long-term contractual relationships for developing public infrastructure and services are focused on pure financial aspects and, primarily, one more possibility to get a profit. This shows that to make investment in public infrastructure attractive for the private sector, the key efforts should be concentrated on developing conditions which could increase the financial viability of IPs and ensure a reasonable profit in a market.

1.1.3. Conception of evaluating the private sector's possibilities to optimize investments in public infrastructure

According to Buškevičiūtė & Raipa (2011), in modern society, decision-making stands out in one important aspect, i.e. the use of analytical models and methodologies which are intended to streamline decisions. The conception of a good decision is usually identified with efficiency, effectiveness, rationality and optimality. All of them are widely used within the context of public investments, although not always exactly according to their definitions. However, in scientific literature, the attention to purifying their interpretation is also comparatively low; sometimes they are mistakenly used as synonyms, especially the concepts of efficiency and effectiveness.

In general, efficiency is considered as the state of being able to accomplish something with the least waste of materials, energy, efforts, money, and time i.e.

having competency in performance. Accordingly, efficiency regarding public investments should be considered from the perspective of LLC: construction, operation and maintenance costs need to be taken into account (Hanák & Muchová, 2015). The effectiveness of investments is considered to be the degree to which objectives of IP are achieved or the extent to which the targeted problems are solved by implementing investments. In contrast to efficiency, effectiveness is determined without reference to costs. Effectiveness means 'implementing right investments', whereas efficiency means 'implementing investment right'. The concept of rationality is mostly related to the means which are used to decide the most efficient alternative of investment implementation and the implementation of the investments itself. It refers to the state of being reasonable, based on facts or reasons. Combining all three concepts, efficiency in the public sector is considered as an efficient investment policy, efficient and effective decisions for its implementation, rational use of public resources and effective performance results. Therefore, one of the most important priorities in the public sector is as efficient and rational use of resources as possible (Carbonara & Pellegrino, 2014; Gordon et al., 2013; Janssen et al., 2016; Kateja, 2012).

This, in turn, requires rational behavior. According to Buškevičiūtė & Raipa (2011), rational behavior is a criterion of efficiency. Being efficient means to choose the shortest way and the cheapest means to achieve the desired goal. An efficient decision is identified with being implemented on time and impartially, considering public interests, rationality, efficient allocation of resources, minimal costs, also ensuring openness and transparency of its making and solving the problem fully with regards to the determined goals. Therefore, the concept of efficiency is concurrent with the assessment of alternative means used to achieve appropriate goals. The assessment of alternatives is usually based on measuring the ratio between inputs and outputs, efforts and results, expense and revenues, benefits and costs. Here, the last of the above-mentioned concepts, optimality can be defined, which is considered to be the state of having the maximized ratio between benefits and costs. However, unlike efficiency, this concept, having a link with rationality, additionally includes the aspects of affordability and viability, since the most beneficial alternative should also be financially affordable and financially, legally, technically, etc. viable to be implemented in practice.

Figure 1.1. discloses the context in which the concept of optimization regarding the research topic has been developed accordingly. As it is shown, optimization as a process is based on an integrated implementation of the concepts of efficiency, effectiveness, rationality and affordability. Their specific application in the context of public investments where optimization is identified with financial and economic aspects of investments' implementation as well as matching of different interests of the public and private entities determines that in this dissertation the optimization of public investments is considered as the comparative assessment of all available options of investments' implementation in order to find the optimal one, i.e. an affordable and viable option providing the highest ratio of benefits and costs (VfM) for the public sector.

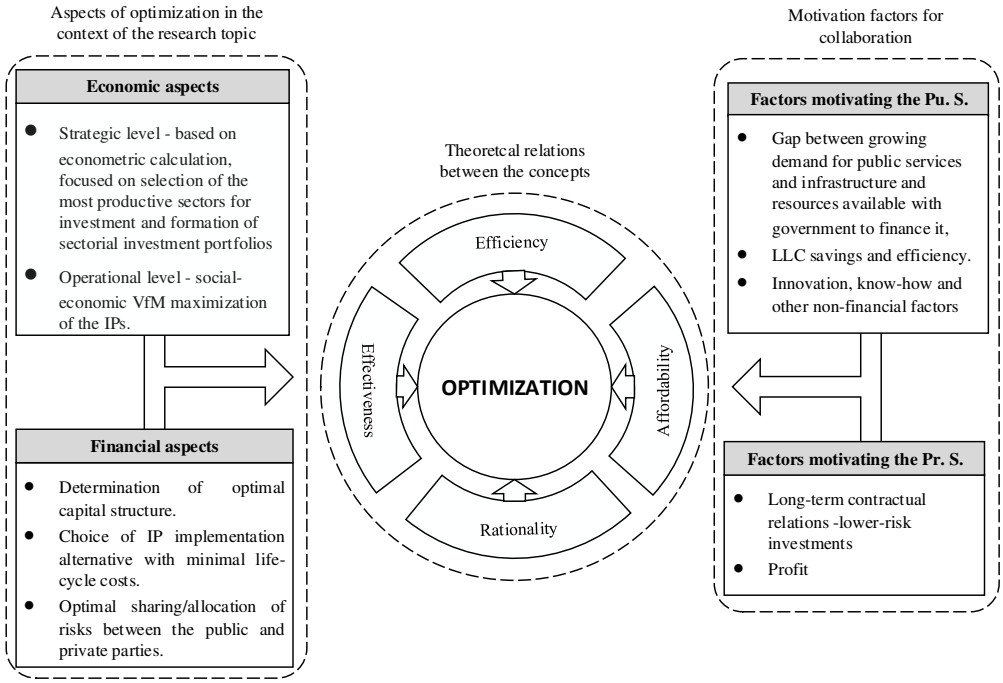

Figure 1.1. Context of the concept of optimization regarding the research topic (prepared by the author of this dissertation)

Beside the CP, the long-term cooperation with private entities is also one of the alternatives which is rational to assess for the purpose of optimizing public investments. In the section above, multiple factors encouraging the private sector to get involved in the provision of public infrastructure show the potentiality of private entities to provide additional benefits to the public sector. However, private entities also have their own expectations, which can result in higher costs for the public sector. Therefore, rational behavior requires an ex-ante assessment of the private sector's possibility to optimize investments in public infrastructure.

Since private participation is an available alternative, firstly, the traditional option of the public sector needs to be assessed in order to evaluate additional benefits and costs, which may arise due to the participation of private entities. Then, different collaboration models and schemes have to be compared, among which the most beneficial with the available resources can be compared against the best conventional option. In theory, it is logical to go into a long-term partnership with private entities, if the comparative results of both options are in favor of the private one; otherwise, if public budget is available, the conventional option of public investments' implementation is the optimal solution[7] (Ball, 2011; Fernandes et al., 2015; Gouveia & Raposo, 2012; Grimsey & Lewis, 2005; Gupta et al., 2013;

[7] The availability factor determines the most critics on this method presented above; however, it is discussed in more detail in Section 1.3.1.

Khadaroo, 2008; Tsamboulas et al., 2013; Felix; Villalba-Romero & Liyanage, 2016; Yin Wang, 2015).

All of the above-analyzed factors of investment optimization allow defining the concept of the evaluation of the private sector's possibilities to optimize investments in public infrastructure as the comparison of the best available options of both the conventional implementation of investments and one with the private entity in a long-term relationship, the results of which, considering the financial possibilities of the PPA and other restrictions, allow making rational decisions for the optimal option of investment implementation in public infrastructure.

Accordingly, the next section of this dissertation presents the theoretical analysis of the PPP as a possibility to optimize investments in public infrastructure.

1.2. PPP as a possibility to optimize investments in public infrastructure

The PPP is globally accepted as a potential alternative to the traditional way of implementing public investments as well as delivering public infrastructure and services by the public sector alone. Thus, this section begins the analysis of PPP as a theoretical possibility to optimize investments in public infrastructure with an analysis of PPP conception and definition. Further, the evolution of PPP is shortly reviewed and a comparative analysis of its forms and schemes mostly used for collaboration between the public and private entities is provided. Later, the advantages and disadvantages of PPP against CP are analyzed. Finally, the structure of PPP is described, and the interests and expectations of all parties are reviewed.

1.2.1. The conception and definition of PPP

The concept of PPP is not consensual. The uncertainty regarding the concept is primarily determined by a broad content of the very word 'partnership', under which lie dozens of collaboration forms and mechanisms especially in the last two decades appeared. Dūda (2010) has identified five different groups of PPP conceptions:

- PPP as institutionalized cooperation between the public and private sectors for a joint delivery of public goods and sharing all the risks involved;
- PPP as long-term infrastructure IPs, in which strict requirements for the outcome of the contract are determined;
- PPP as the public policy and management networks, which emphasize free mutual relationships of stakeholders;
- PPP as the development of civil society and sociality;
- PPP as urban renewal and economic development.

Each of these coherently-mentioned conceptions emphasizes a gradually widening approach to the relationship of the public and private sectors and herewith complement each other. They reveal the aspects of cooperation, mutual interest, durability, risk allocation, benefit sharing and others that allow to primarily perceive PPP as a complex multidimensional phenomenon, which is also emphasized by many scientists (Ball, 2011; De Clerck & Demeulemeester, 2015; Desgrées du Lou, 2012; Janssen et al., 2016; Kokkaew & Wipulanusat, 2014; Martins et al., 2011; Sarmento & Renneboog, 2016; Shaoul et al., 2012; Felix; Villalba-Romero &

Liyanage, 2016; Zangoueinezhad & Azar, 2014). Kavaliauskaitė & Jucevičius (2009), and Urbonavicius (2010) also provide an appropriate classification of conceptions, depending on their scope. They conclude that some of the conceptions are very broad, i.e. when on a contract, privilege and grant basis the public and private sectors decide on the relatively short-term and very specific purpose to provide public goods or services, organized by public authorities, provided by private entities and funded by tax payers or/and paid with the direct charges from users. In other case, PPPs can be considered as complex infrastructure IPs, terminated by a certain type of their privatization. However, the narrowest and most accurate group of PPP conceptions includes innovative ways of developing public services and infrastructure. This discloses the broad nature of PPP conception and allows stating that the PPP fills the space between pure public provision on the one hand, and outsourcing or total privatization on the other hand, which embodies a broad range of possible applications.

The existence of many conceptions determines that the scope of PPP conception is still a subject to considerable debate. It should be mentioned that the terminology in respect of PPP is also not consensual. There are many alternative names for PPP:

- Private Finance Initiative (PFI) is a term originating in the Great Britain, and now also used in Japan and Malaysia. It is also considered, as it is revealed in the following section of this dissertation, as a certain form of PPP;
- Private Participation in Infrastructure (PPI) is a term used by the WB and rarely met outside the development-financing sector;
- Privately-financed Projects (PFP) is a term used in Australia;
- Private-Sector Participation (PSP) is a term used in the development-banking sector;
- P3 is an acronym mostly used in the US and Canada.

However, PPP and 'Public-Private Partnership', originating in the UK, are the umbrella acronym and term covering all the above-mentioned names, respectively. They became popular in the early 1990's (Babatunde et al., 2015; Bernardino et al., 2010; Khadaroo, 2008; Parker & Hartley, 2003; Pauliukevičiūtė, 2010; Shaoul, 2011; Urbonavicius, 2010) and generally have been used to define a wide range of working relationships between the public and private sectors ranging from an informal dialogue to a complex service agreement to design, finance, build, operate and maintain public infrastructure.

In a broad sense, the PPP is considered as cooperation between the public and private sectors for providing public services and/or implementing the IPs of public infrastructure. However, the absence of unanimous conceptions of PPP also complicates various attempts to develop a univocal and unchallenged definition of PPP which would be more precise. Moreover, there are multiple PPP models and schemes that change from country to country, are applied to different sectors of activity, which, in turn, creates additional difficulties in establishing a universally accepted definition (Liu et al., 2015; Mota & Moreira, 2015). The approach to PPP also varies in every country, depending on the settled relationship between the

public and private sectors and developed legal framework determining economic sectors, activities, forms and schemes available for their cooperation[8] as well as other aspects of PPP's implementation (Grimsey & Lewis, 2005; Viegas, 2010). All the above-mentioned reasons determine the existence of dozens of PPP definitions across the practical guides and scientific literature.

Appendix 1 provides a list of PPP definitions found in scientific literature. Their content analysis disclosed that PPP is mostly defined through such keywords as long-term partnership and cooperation, contractual agreements, transferring the delivery of infrastructure and services to the private sector, and risk sharing and allocation. There are also such keywords as financing, delegation of functions, innovation, competence, expertise, procurement and some others, however, they are used relatively less frequently. These results allow emphasizing the following common aspects related to the definition of PPP.

One of the most important aspects is naming the public and private sectors as cooperating partners (Roll & Verbeke, 1998; Rudžianskaitė–Kvaraciejienė, Apanavičienė, & Gelžinis, 2015; Urbonavicius, 2010; Wojewnik-Filipkowska & Trojanowski, 2013; Xu et al., 2012; Zangoueinezhad & Azar, 2014). They are divided into the public partner and the private partner, respectively. The public partner is responsible for the assurance of public infrastructure and services for a society and seeks welfare maximization. While the private partner is a business entity to which, depending on the form of PPP, appropriate tasks are transferred in return for periodic payments from the public budget or/and the possibility to earn from the revenue gathered from direct users for the provision of services. Different purposes of these entities, as discussed in Section 1.1.2., lead to a conflict of interest. According to Bao et al. (2014), Carbonara et al. (2014), Hanaoka & Palapus (2012), Yu & Lam (2013), and Spackman (2002), although before signing the agreement the public entity usually has greater bargaining power to make good decisions for itself, the private entity also has to be offered such conditions of collaboration which are attractive and encourage to participate in the PPP. Therefore, most definitions emphasize the aspect of mutual (contractual) agreement, based on which the benefits and risks for both partners are allocated (Ashuri et al., 2012; Gordon et al., 2013; Grimsey & Lewis, 2002; Gudelis & Rozenbergaitė, 2004; Jin & Zhang, 2011; Mu et al., 2011; Poulton & Macartney, 2012; Roehrich et al., 2014; Rudžianskaitė–Kvaraciejienė et al., 2015; Sambrani, 2014; Sharma, 2007; Tamosiunas & Zilakauskyte, 2010; Felix; Villalba-Romero & Liyanage, 2016; Xu et al., 2012). According to Kurniawan et al. (2015), Li, Akintoye, Edwards, & Hardcastle (2005), Sambrani (2014), Zhang (2014), only mutual beneficial PPP can be successfully implemented due to the synergy effect. Therefore, the cooperation aspect of the PPP concept is crucial in its definition.

Regarding the definitions of PPP, great attention is also paid to determine the cooperation period which is characterized as long-term (Carbonara et al., 2014; Grimsey & Lewis, 2002; Roehrich et al., 2014; Rudžianskaitė–Kvaraciejienė et al., 2015; Shaoul et al., 2012; Zangoueinezhad & Azar, 2014; Xueqing Zhang, 2011). A

[8] What is considered PPP in one countries can be not considered in others.

PPP lasts on average 20–30 years (Cruz & Marques, 2013; Qiu & Wang, 2011; Wang, 2014; Zhang, 2014); however, according to Viegas (2010), there are also examples of PPP agreements which cover a period of 60 or even 99 years. A long period is usually required to make the IP financially viable. However, this aspect also suggests that due to the difficulties to objectively foresee all possible changes which may occur during the planned period of PPP, the contracting of PPP is a challenging process.

The aspect of risk transferring to the private partner or its sharing and allocation between the public and private partners is also often emphasized (Molen et al., 2010; Poulton & Macartney, 2012; Roehrich et al., 2014; Sambrani, 2014; Sharma, 2007; Felix; Villalba-Romero & Liyanage, 2016; Zangoueinezhad & Azar, 2014). This allows stating that transferring a part of risks to the private entity, at least that associated to building and maintenance of public infrastructure and provision of public services, is considered an integral characteristic of PPP. Moreover, the definitions also disclose that beside the transfer of risks, the PPA also can expect to get better financial accessibility in the PPP, as well as specific private partner's knowledge and to be provided with innovations, which, in turn, highlight the aspect of public sector's reform.

Beside risk sharing and allocation, the aspect of investments needed to be financed from the private partner in the PPP are also frequently mentioned (Liu et al., 2015; Poulton & Macartney, 2012; Roll & Verbeke, 1998). This indicates that private capital participation in the development of public infrastructure is one of the integral features of PPP. However, this is not a strict rule, e.g. a particular type of management contracts, in which the private entity does not provide capital investments, are also sometimes considered as a form of PPP (de Jong et al., 2010; Devapriya, 2006). However, due to the same characteristics, this attribution of management and similar contracts is more prevailing in the scientific literature, where different forms of PPP are analyzed considering different allocation of risk between the public and private entities than those in legal documents.

Many authors (Ahmed & Ali, 2006; Dūda, 2010; Hellowell, 2013; Khadaroo, 2008; Valila, 2005) emphasize that the PPP is becoming an important means for reforming the public sector and transforming it according to the principles of the market. The public entity, cooperating with the private partner and absorbing its experience, can learn to perform more efficiently and use the acquired competence in other fields of the public sector. In this way, the development of PPP affects not only the sector where it is implemented but also may indirectly contribute to the total efficiency growth of the public sector.

Considering all the above-mentioned aspects revealed in the definitions of PPP, the author of this dissertation generally defines PPP as a *long-term contractual cooperation between entities of the public and private sectors, based on which the provision of public infrastructure and services is transferred to the private partner by rationally using each of the partners' competences and optimally allocating resources, costs, risks and benefits; due to the transfer of the private sector's knowledge, innovation and experience, creating possibilities for higher efficiency of these public infrastructure and services' provision.* Such definition precisely

describes the nature of PPP; however, due to the above-mentioned complexity it can be not accurate in all cases. This, according to Viegas (2010), is a problem of all definitions of PPP.

Therefore, instead of trying to find a unanimous definition of PPP, many researchers concentrate more on the description of its forms and their features. Some scientists simply describe the PPP as one alternative structure or tool for implementing IP's public infrastructure and services, i.e. the mid-way between the CP and outsourcing or privatization[9] (Karlavičius, Karlavičienė, & Grigonienė, 2006; Skietrys & Raipa, 2009; Yin Wang, 2015). Hall (2008) generally doubts the existence of PPP as an independent form of public infrastructure and services' provision. According to Dunn-Cavelty & Suter (2009), and Parker & Hartley (2003), the title of PPP appeared in use in the UK as a softer alternative for compromised privatization in order to mitigate the negative reaction of society to the aims of Margaret Thatcher's investment policy to attract the private sector to participate in the provision and development of public infrastructure and services. Despite the different idea and content of PPP, it was defined as a specifically flexible form of privatization which can become a convenient means to mask the actual goals of governments, i.e. privatization, decrease of the public sector and contribution to the private suppliers by, in most of cases, transferring them the provision of monopoly services. There is an agreement that the PPP has some elements of privatization; however, generally it cannot be identified with it for the following reasons:

- In the PPP, the public asset is not sold, but only transferred to the private entity to manage and operate it for a determined period. At the end of the period, the fully operational asset is transferred back to the host government, usually at nominal or no cost[10].
- In PPP agreements, public responsibility is still retained, i.e. the PPA, as a distinction from privatization, can influence the process of public services' provision, control the performance of tasks transferred to the private partner and determine the main service standards.
- The public sector, even in the absence of direct participation in the provision, is responsible for the public infrastructure and services provided in the PPP. Therefore, the PPP can be applied for the provision of monopolistic services.

All the above-mentioned reasons allow stating that the main distinctions of PPP compared to outsourcing or privatization assert in the preservation of the public sector's influence on the decision-making and property rights, which, as leverage of power, can be used to defend public interest in the PPP. Herewith, they can be identified as significant characteristics of PPP. In addition to these, various scientists

[9] Outsourcing and privatization are different policies to provide the public infrastructure and services. In comparison with traditional procurement from the perspective of possible-to-transfer activities, both are at the opposite sides of the spectrum.

[10] In PPP-based economic interest, a newly built infrastructure can also be left for the private entity at the end of the cooperation period, if this was agreed between the parties before signing the PPP contract.

(Benito et al., 2008; Bernardino et al., 2010; Karlavičius et al., 2006; Ke et al., 2008; Lawther & Martin, 2005; Li et al., 2005; Macário, 2010a, 2010b; Meunier & Quinet, 2010; Reeves, 2005; Urbonavicius, 2010; Wang, 2014; Wojewnik-Filipkowska & Trojanowski, 2013), as well as the (European Commission Directorate General Regional Policy, 2003) also highlight the following general characteristics of PPP:

- It involves several participants, among which one is a public entity and another one is a private entity in a long-term relationship;
- Multiple tasks are integrated in one contract. Such tasks as design, construction, maintenance, operation are integrated in one contract;
- Along with the integration of multiple tasks, there is a substantial transfer of risks to the private party, e.g. the risks of cost overrun, delays in construction, weight of operational and maintenance expenditures, availability to use, etc. may be transferred to the private party. This distinguishes the PPP from more traditional forms of procurement, when most of the risks are borne by the public party. However, this also does not necessarily mean that the private party assumes all the risks in PPPs. In a PPP, risks are allocated between the public and private parties case by case that, in turn, determines which of the parties will own the developed assets, what are the liabilities of all parties, the restrictions in operation and guaranties for the private party.
- The private partner is responsible not only for delivering the asset, but also for providing the appropriate services during the contractual period. The PPA determines the quality standards, quantitative requirements, pricing policy, etc. of the services provided as well as monitors and controls the results of their realization.
- Only the results of services are purchased, i.e. a process is established, which enables to provide the necessary and conditioned services over the entire life cycle of the IP. The private partner undertakes the design and construction of an asset based on the output specification prepared by the procurer and designed to meet broad performance targets.
- At least partly, investments are financed by private capital, while all financing for the IP can be raised by means of complex arrangements between various players from the private sector, such as investors, banks, pension and insurance funds, EU structural funds, international donors, etc. However, public funds, in some cases rather substantial, may also complement the private funds.
- Despite different interests, the communication between the PPA and the private partner is based on collaboration and partnership, not confrontation. Both partners have wide discretion, but work harmoniously.

Each of these characteristics complements and elaborates the earlier-provided definition of PPP. Their generalization allows stating that each partner plays an important role in the achievement of common goals of PPP. This is visible in the invested both tangible and intangible resources as well as mutual intentions to

cooperate and compromise, which is the essence of partnership. In a mutually beneficial relationship based on rational allocation of risks, which efficiently uses the competences of each party, the tasks are performed efficiently and the predetermined results are achieved.

Since the main features of PPP have already been analyzed, the key differences between CP and PPPs are explained in Table 1.1 for a comprehensive disclosure of PPP conception. These differences determine the advantages of PPP against CP, which are analyzed in Section 1.2.3.

Table 1.1 A comparison of CP and PPP (prepared according to Commonwealth of Australia, 2008; HM Treasury, 2012)

CP	PPPs
Short-term design and construction contracts. The PPA manages multiple contracts over the life of the facility	One long-term contract (usually 15–30 years) integrating design, building, finance and maintenance of the facility.
Purchase of an infrastructure asset	Purchases of services and availability of infrastructure
Requirements tend to be specified on an input basis.	Requirements are specified as outputs to maximize private sector innovation.
The government operates the facility	The government may or may not operate the facility
The PPA usually holds the risk on construction delays and cost overruns.	The private sector party holds the risk of construction delays and cost overruns to provide incentives for delivery to time and to cost.
The PPA pays the costs of construction, maintenance and services as they arise.	All costs are included in a "unitary" payment which is fixed and inflation-adjusted over the life of the contract and is not payable until construction is complete and services have commenced to an agreed standard.
The PPA pays the capital costs at the beginning of the project through capital budget.	The capital costs of construction are financed by the private sector borrower, and the costs are amortized over the life of the project.
Borrowing is financed through the issuance of government gilts, managed on a government portfolio basis.	Borrowing is financed by the private sector on a project-by-project basis.
Payment for maintenance and services is not generally linked to performance.	The unitary charge payments are linked to a performance regime. Deductions may be made if services are not delivered to contractual requirements.
There is no long-term contractual commitment for the provision of maintenance. Authorities can flex their requirements and the costs of maintenance. Only a small number of authorities put in place planned maintenance regimes.	The public sector pays for ongoing maintenance and life cycle replacement costs as part of the annual unitary charge, and the costs are, therefore, smoothed across the contract term. This means that the asset is appropriately maintained over the project's life, but the costs of maintenance are effectively locked in over this period.

The analysis of PPP's conception and definition has explained its essence, content and differences from the CP. However, this analysis is not sufficient to reveal all details associated with the differences between the main forms of the public and private sectors' cooperation in PPPs. Therefore, to further analyze the PPP as a possibility to optimize investment in public infrastructure, it is relevant to analyze its development and main forms.

1.2.2. Development and forms of PPP

Although the concept of using private capital to provide public infrastructure facilities and services is not new anymore[11], the intense development of PPP and its application in the public sector, which resulted in a significant increase in the volume and number of PPPs across the globe, has started only since the early 1990s, when the UK had developed a systematic program of PPP (Babatunde et al., 2015; N. Wang, 2014). For years, the prevalence of PPP was limited and its potential was not envisaged until 1979, when the elected conservative government with Margaret Thatcher ahead started to implement a new policy of public infrastructure and services' provision. This policy emphasized the changed preferences of politicians about the proper role of government, resulted in a reduction of the public sector's size, and an increase of the private sector's role in the delivery of public infrastructure and service, including the participation of a private equity (Baker & Burdman, 1996; Lawther & Martin, 2005; Yinglin Wang & Liu, 2015; Whiting, 2013).

The main drive[12] to attract private capital into the provision of public infrastructure and services was government's need to control public spending and deficit of the budget. For this purpose, in 1981, the so-called "Ryrie Rules" were issued[13], which, according to (Clark & Root, 1999; Hall, 1998; Heald, 1997) determined that:

1. decisions to provide public funds for investment have be taken under conditions of fair competition with private sector borrowers, which in turn, means that private finance could only be used if there were no favorable risk terms, such as government guarantees or commitments, or monopoly power, schemes offering investors a degree of security greater than that available on private sector's IPs;
2. such IPs should yield benefits in terms of improved efficiency and profit from additional investment commensurate with the cost of raising risk capital from financial markets;
3. public expenditure would be reduced in comparison with the hypothetical PSC, even if budget constraints would mean that the public sector's alternative would not be feasible.

All the above-mentioned conditions were determined upholding the view that there is little macroeconomic difference between government borrowing from the market to finance public expenditure, generally, and the private sector borrowing for, essentially, IPs, the primary objective of the Ryrie Rules was to stop the ministers from insulating private finance from risk so that it could be used to

[11] See Section 1.1.1

[12] Among other aspects encouraging the public sector to go into a long-term partnership with the private sector, provided in Section 1.1.2.1

[13] These rules were named after Sir William Ryrie, Chair of the National Economic Development Council (NEDC) Working Party that formulated the 'Report of the NEDC Working Party on Nationalized Industries Investment'. The Report defined the terms on which private capital could be used in nationalized industries in the 1980s.

circumvent public expenditure constraints. Practically, investments into public infrastructure could be implemented in a way of CP, only if the results of VfM assessment for PPP implementation were not in favor of this route. However, despite the significantly higher cost of private finance, the vast majority of assessed IPs was found to be in favor of the PPP option. Accordingly, this disclosed that PPAs are subject and biased towards the PPP methods as well as VfM assessment is subject to manipulation and financial assessment; more specifically, it is unlikely to be fundamentally sound. Therefore, since all assumptions used in the VfM assessment which favor PFI could not be based on objective and high-quality evidence, the support of Ryrie Rules started to gradually decrease until it was abolished in two stages in 1989 and 1992 so that VfM assessment would no longer be required, if either the IP could be financed with user charges or there was no real possibility to implement the IP by using public resources (Grimsey & Lewis, 2005; Hall, 1998).

Nevertheless, it was the increasingly growing general understanding that the private sector can offer better VfM in the provision of public infrastructure and services. In addition, a lack of government budget to finance all infrastructural needs has encouraged the incentives to look for non-governmental resources, i.e. the private capital. Therefore, to attract additional financing, in 1992 the PFI was initiated. It introduced "Universal Testing Rules", according to which every IP had to be tested against the PFI before being allowed to be implemented in a conventional way. This encouraged to start many PFI IPs; however, the application of UTR has been also widely criticized for clogging the system and delaying the approval for important IPs. Moreover, at that moment, the legislation for private participation in the provision of public services had not been clearly defined yet. Therefore, the incoming Labor government abandoned the UTR, and introduced a new and now globally well-known concept of PPP in 2000, primarily based on a mutually beneficial voluntary cooperation between the private and public sectors (Grimsey & Lewis, 2005; Gudelis & Rozenbergaitė, 2004).

In parallel, however, at different speed and lower scope, the collaboration between the public and private sector has also developed in other countries. Many scientists (Acerete et al., 2011; Ball, 2011; Barlow & Köberle-Gaiser, 2008; Benito et al., 2008; Bernardino et al., 2010; Burke & Demirag, 2015; Carbonara & Pellegrino, 2014; de Jong et al., 2010; English & Guthrie, 2003; Galilea & Medda, 2010; Gudelis & Rozenbergaitė, 2004; Gupta et al., 2013; Harada & Ogunlan, 2015; Hwang et al., 2013; Yescombe, 2007; Mu et al., 2011; Sambrani, 2014; Šutavičienė, 2011b; Wojewnik-Filipkowska & Trojanowski, 2013) analyzed the practical experience of PPP implementation and development in the UK, the USA, Australia, France, South Korea, Spain, Poland, India, Germany, Belgium, China, Singapore, Japan, Italy, South Africa and other countries. Their review disclosed that there is no unique PPP implementation framework among the countries. In every country PPPs tend to be structured and performed case-by-case, while the very process is influenced by various economic, financial, legal, institutional, political and other factors, due to which it is complicated to generalize the framework. However, a tendency was observed that the transport sector and the road sector, more specifically, was one of the first which involved private participation more

extensively. Over time, many countries have also established the PPP units (World bank, 2016a), the overall objectives of which were to be an integral part in developing and implementing the policy and regulatory reforms as well as building the institutional, legal and social foundation needed to enable, promote and facilitate efficient and sustainable private investments in public infrastructure. Their importance is still growing, since a tendency is observed to centralize the process of PPP implementation because the development of PPP's skills and competence in all public institutions requires more public resources and, therefore, tends to be less cost-efficient (Sarmento & Renneboog, 2016).

Currently, the PPP is widely applied in the global public construction and service market. It is implemented in many areas: developing, maintaining and operating the infrastructure in the sectors of health, education, transport, tourism, public security, communication, energy, public defense etc., as well as providing public services and utilities, such as water and sanitation, electricity, gas, heating, etc. Among these, the sectors of electricity, information and communication technologies (ICT) are relatively dominant all over the world (World bank, 2016b). In the EU the majority of PPP are implemented in the sectors of transport, education and health (EPEC, 2014, 2015a, 2016). However, despite these general tendencies, the level of PPP market development and sectors in which this way of public infrastructure and service delivery is applied highly differ among countries. According to Grimsey & Lewis (2005), this depends on many factors, such as the prevailing relationships between the public and private sectors, public investment policy, the level of government's debt, general economic situation, etc.

Considering the observed tendencies of similarities between economic growth and development of PPP market in the member states of the EU[14] (EPEC, 2014, 2015a, 2016), the latest of above-mentioned factors has been analyzed in more detail. More specifically, the author of this dissertation (Jasiukevicius & Vasiliauskaite, 2013) has analyzed the impact of GDP growth on PPP market's size in respect of both the number of PPP deals and the amount of capital investments. The statistical analysis disclosed that GDP growth as a factor can alone clearly explain the general changes in the PPP market, though the general tendency of PPP market to reflect the changes of GDP growth was observed. However, only in the longest period, in respect of available data of 16-years correlation ($R^2 = 0{,}795$), was estimated as statistically significant (Sig. 0,000). While among the member states with the most developed PPP market, the correlations of GDP growth with the number of PPP deals were statistically significantly stronger than with the amount of capital investments. However, in both cases, the relationships can be considered as conditionally no stronger than medium level, $R^2 = 0{,}426$ and $R^2 = 0{,}603$ (Sig. (2-

[14] Over two decades starting from 1995, the total number and value of PPP deals contracted in the member states of the EU, irrespective of the dates when they joined the EU, have increased more than one hundred times. Especially, the PPP market increased in the period of rapid economic growth and, after reaching its peak in 2006–2008, has considerably declined in the period of economic crisis in 2009–2012 and, though it returned to positive growth later, the PPP market remained quite modest and similar to the general development of economy in the EU.

tailed) = 0,000), respectively. Moreover, it was also found that there is no statistically significant difference between the strength of correlation of the PPP market development with the predictive and current data of GDP growth. Therefore, although stronger relationships with prognosticated data were estimated, it cannot be confirmed that the prognosis of GDP growth has any impact on the decisions to launch PPP as well as determine a certain amount of capital investments than the data of a current situation. Since PPP frameworks are mostly developed in the most economically advanced member states, such as the UK, France, Italy, Spain, the Netherlands, Belgium, etc. the strength of relation of above-mentioned variables between the states net contributors and net recipients was also analyzed. However, no statistically significant difference was found, except for the case of correlation between GDP growth and the amount of investments in the analyzed group of 25 EU states (Sig. (2-tailed) = 0,014). However, the correlations are conditionally very low, $R^2 = 0,384$ and $R^2 = 0,603$, respectively, thus makes the relevance of these results to be treated with caution. Accordingly, more results are presented in this research.

Returning from the research to the development of PPP in the world, it is observed that the most advanced countries in the field of PPP are the UK, the USA, Australia, France, Spain, Japan, Germany, Turkey. They established not only particular authorities responsible for PPP framework development, but also developed special legislation clearly regulating contractual relationship between the public and private entities.

Meanwhile, the development of PPP market in Lithuania in comparison with other member states of the EU is relatively modest. The PPP as a way of delivering public infrastructure and services is still applied only in individual IPs. There are no economic sectors where the systemic application of PPP is applied. Data of the WB (World bank, 2016b) show that only 13 PPPs have reached financial closure over the period of 1990–2015, most of them are concessions in the sectors of electricity and information and communications technologies. The European PPP Expertise Centre (EPEC) has counted 3 PPPs during the period of 2010 and 2016 (EPEC, 2010, 2015a, 2016). Meanwhile, the PPP Unit of Lithuania (PPP Unit of Lithuania, 2016) has highlighted 24 PPPs from many different sectors; however, most of them have been in various phases of procurement. A relatively small number of PPPs discloses that the potential of PPP as an alternative way of delivering public infrastructure and services are not fully used in Lithuania. The reasons determining this situation are analyzed in more detail in the latter section of this dissertation.

Over the last two decades, the intense development of PPP as an alternative way of delivering public infrastructure and services has determined the rise of a broad spectrum of forms and schemes of its implementation from the municipality's contract with the private subject from the management of infrastructure on the one hand, to the establishment of common capital joint venture of the public authority and private firm for the implementation of a major IPs. For the purpose of classification, scientists draw a line between various forms of PPP depending on whether they are established on a contractual or institutional basis (Grubišić Šeba et al., 2014; Tang, Shen, & Cheng, 2010; Valila, 2005). Accordingly, among different possible classifications, scientific literature distinguishes two main types of PPP

forms: the PPP of purely contractual nature (the contractual PPP), and the PPP of institutional nature (the institutional PPP). Both types involve transferring the traditional public sector's tasks to a private entity; however, each of them also emphasizes certain characteristics.

The institutional PPP is cooperation between public and private partners by establishing a joint-stock entity[15], which is responsible for ensuring the delivery of a particular public infrastructure and/or services on behalf of the public sector. The institutional PPP can be implemented either through a new entity established especially for the delivery of predetermined services, or through an existing public entity, a part of which shares is transferred to the private entity in exchange for predetermined obligations. The PPA, as a shareholder, usually having a major part (50% plus one) of shares or special rights (golden share) controls the private entity (Martins et al., 2011). The rights and obligations of the private entity are guaranteed by the shareholder agreement between the public and private parties. Depending on the sharing ratio of benefits and risks, each of the partners invests an appropriate part of resources. This type of PPP forms can be characterized by a high degree of formalization of the relationship between the public and private entities (Batran, Essig, & Schaefer, 2004). However, it is useful, if the public entity wants to strategically control the delivery of public infrastructure and services, since it provides some flexibility over time according to the changing needs (Dūda, 2010). Moreover, it allows solving conflicts internally as well as acquiring the know-how for the public partner from the joint activities performed with the private party.

The contractual PPP is characterized by, in comparison, a lower level of formalization and adaptation of each partner. It confines cooperation only on contractual basis without establishing a joint-stock entity for the implementation of an IP (Batran et al., 2004). In other words, in the contractual PPP, the mutual relationship between the public and private partners is regulated solely by contractual links, and each of the partner's rights and obligations are determined by one or series of contracts.

In the scope of both types, depending on the characteristics of the contractual relationship and delegation of tasks to the private partner, many different forms of public-private provision of infrastructure and services are distinguished[16] (Dūda, 2010; Hall, 2008; Hemming, 2006; Karlavičius et al., 2006; Kavaliauskaitė & Jucevičius, 2009; Tang et al., 2010; Valila, 2005; Y. Zhang, 2014). The following forms of PPP are best known:

[15] According to Grubišić Šeba et al. (2014), in the institutional PPP, the public partner usually has minority ownership stake. However, in such countries as Lithuania, minimum share of government capital is regulated by the rule that the public sector must own at least 50% of ownership plus one i.e. the public sector must have the control power ("LR Valstybės ir savivaldybių turto valdymo, naudojimo ir disponavimo juo įstatymas (2014 m. kovo 25 d. Nr. XII-802, 22 str. 9 d.),").

[16] Depending on the country, not all forms of collaboration between the public and private entities are acknowledged as PPP.

Service contract[17] is relatively the simplest form of cooperation between the public and private entities, also emphasized by the lowest level of each entities' integration for ensuring the delivery of public infrastructure services. Under the service contract, a public authority hires a private entity to carry out specified tasks or services for a determined period. The public authority remains the organizer of service and the primary provider of the infrastructure service; it is also responsible for funding any capital investments required to expand or improve the service infrastructure and contracts out only portions of its operation to the private entity, which, in turn, has to ensure the efficiency of performance. The public authority decides, which services[18] are provided by the private entities and sets standards of their quality. Meanwhile, the private entity must perform the service at the agreed cost and must meet the quality standards set by the public authority. In return for the provided services, it is paid a predetermined fee, which may be based on performance time, unit cost, or other basis. Therefore, the profitability of a contract depends on how much the private entity can reduce its operating costs, while satisfying the required standards of service. To increase cost efficiency, PPAs use competitive bidding procedures to award service contracts. Usually, the service contracts are the shortest in terms of duration among other forms of PPP, typically 1–3 years. The examples of the form could be contracts of maintenance and operation of water pipes, electric lines, etc.

As a form of PPP, the service contract is suitable where the specification of services can be clearly defined, the demand of services is clear and stable and the performance can be monitored easily. Due to transferred technologies and provided managerial capacity, it can have a quick and substantial impact on the efficiency of performance of particular tasks. However, the service contract is not suitable to attract capital investments because under this arrangement the private entity has no obligation to provide capital financing. Since private entities participate only in the performance of one or several tasks needed to provide services, it is difficult to expect a broader or deeper impact on the total performance, mostly discrete and limited improvements, instead. Moreover, there are little low-risk options to expand the role of the private entity. As a result, the public sector remains in charge to set tariffs and develop infrastructure, both of which are crucial to sustain the provision of services.

Management generally is a short-term, usually 2–5 years, contract under which the provided infrastructure and services remain public, but some or all tasks related to operational management in order to increase their efficiency are assigned to a private entity which is also usually engaged to interact with the customers. Although under this arrangement the private entity has to finance discrete tasks, in most cases, it provides only the working capital, but no financing for capital investments. The private entity, as a manager, is paid a predetermined fixed rate for labor and other operating costs. It can also be paid additional amounts, if the prespecified targets are exceeded or/and is the parties participate in a profit sharing scheme. The PPA is

[17] Service contract is not considered as PPP in Lithuania.

[18] Usually, these are services where the private partner does not interact with consumers.

responsible for the provision of major capital investments as well as sets the tariffs. The examples of forms could be the management of hospitals, utilities, ports, etc.

As a form of PPP, the management contract has such advantages as allowing many operational gains as the results of management on commercial basis without transferring the assets to the private sector. This makes it relatively easy to develop in comparison with other forms of PPP. Moreover, due to staff optimization and efficient management, lower costs can be achieved. It is used as an arrangement for modest improvements until more comprehensive contracts are developed. However, this arrangement makes it challenging to combine the private entity's objectives of efficiency and the public authority's plan of expansion as well as determine the optimal level of private entity's autonomy required to achieve deep and long-lasting change.

Operation and management (O&M) is an expanded arrangement of Management, additionally including tasks related to operation and maintenance, which are assigned to the private entity. This form can vary in a broad range of contracts from technical assistance contracts to full-developed operation and maintenance agreements and, therefore, it is difficult to generalize them. However, the public entity always retains ownership and overall management of the public facility or system. As a distinction from the management contracts, which tend to be task-specific and input-focused, O&M agreements may have more outputs or performance requirements. O&M is mostly applied in the provision of utilities, such as electricity, gas, water, heating, etc.

Lease (also known as *service concession* or *franchise*), is a contract whereby the service provision is transferred from the public sector to a private entity which undertakes obligations relating to quality and service standards and herewith bears the financial risk for operation and maintenance. Specifically, it is responsible for operating losses and for consumers' unpaid debts. To manage these risks, it tends to employ staff directly. To provide services, it rents infrastructure from the public authority, for which it is charged a fixed rental or lease fee irrespective of the level of tariff collection that is achieved and so the operator takes a risk on bill collection and receipts covering its operating costs. The initial and later major investments in infrastructure are financed by the public authority, which bears investment risks and can recover investments, at least in part, from the rental payment of infrastructure. The duration of the leasing contract is typically between 8 and 15 years.

Affermage is a contract similar to lease. Differences among these contracts are in how the receipts collected from consumers are shared between the entities. Unlike a lease, where a fixed amount of the receipts goes to the awarding PPA as the owner of assets as a lease fee, in the case of the affermage, the private sector collects revenue from the customers, pays the contracting authority an affermage fee, typically an agreed rate per every unit sold, and retains the remaining revenue. This, in turn, allows reducing the risks associated with low-cost recovery in sales. However, in both forms, a portion of the receipts going to the public authority goes into an account that will fund future investments in the assets. Lease and affermage are usually used to operate airport terminals or seaport containers, provide central heating, etc.

In comparison to the above-mentioned forms of PPP, the key advantages of both lease and affermage is that they allow passing the commercial risk to the private entity, since its profits depend on the utility sales and costs and, in turn, provides incentives for the operator to achieve higher levels of efficiency and higher sales. Moreover, under this arrangement a lease/affermage fee is collected, which allows the PPA to cover capital expense when private equity and commercial debt are not available. The potential weakness is related to a complex tariff arrangement, which is usually a very sensitive topic for the society. Moreover, the public authority remains with responsibility to mobilize financial resources for capital investments.

Concession is the right awarded to a private entity (the concessionaire) to manage the state or municipality-owned resources or infrastructural objects and collect payments from user charges in exchange of transferring responsibilities related to designing, financing, building, maintaining, operating of these objects. The private entity gets revenues from the direct users of service. The tariffs and their changes over time are established by the concession contract, respectively. While the PPA is responsible for determining the performance standards and ensuring that the private entity (concessionaire) meets them. It can also provide additional capital financing or subsidies to make IPs financially viable, if the tariff or demand is not sufficient. Since the private entity has to ensure capital investments, the concession contract is typically valid 20–30 years in order to recover the capital investments and to earn an appropriate return over the life of the concession. If the contract is very profitable, various compensation mechanisms, e.g. revenue, profit sharing, to ensure public interest, are usually used. At the end of the concession period, the rented infrastructure is transferred back to the government, while the newly built infrastructure can also be left for the private entities.

Concession is one the most common forms of PPP in the world (Auriol & Picard, 2013; Carbonara et al., 2014; Yu & Lam, 2013; Xu et al., 2012). In comparison with other contracts, concession has some advantages, since it provides incentives to the operator through innovation and management to achieve an improved level of efficiency and effectiveness, which, in turn, results in increased profits and return to the private entity. Moreover, it allows attracting the private financing required for building new infrastructure or rehabilitating and upgrading the already existing one. Concession is most often applied in the development of roads, air maritime, public transport, water, solid waste, smart development, other energy sectors where user charges can be applied. A potential weakness of concession contracts is that they are complex in nature, therefore requiring special competence from the PPA to be prepared and managed. Moreover, long-term duration implies the difficulties to anticipate all circumstances which would have impact on the result of concession's performance, which aggravate the assessment and sharing of various risks.

Private Finance Initiative (PFI) is an arrangement whereby the private entity finances, manages and completes IPs and then delivers the appropriate services and maintenance functions over a determined period, for regular availability payments from the public entity. The private entity provides capital financing; however, the

property rights of assets may belong to the public (in most cases) or private entity[19], but, in any case, at the end of the cooperation period, which usually lasts 20–30 years, the government keeps the ownership of the asset. As the concession, it is also one of the most prevailing forms of PPP, mostly applied in the development of healthcare (Acerete et al., 2011; Barlow & Köberle-Gaiser, 2008), education (Khadaroo, 2008), prisons, public administration and social house infrastructure (Grubišić Šeba et al., 2014; Wang, 2014) and other sectors, i.e. in those sectors where such tasks as construction, operation and maintenance of infrastructure are transferred to the private sector, while the very provision of the main services typically remains with the public sector. The key advantage of PFI is that the private entities, combining tasks of building infrastructure and its operation, can achieve lower life cycle costs of the IP as well as provide capital financing, which can be critical factors determining whether an IP is financially viable for the public authorities under budget constraints. A potential weakness of PFI is related to the same complexity of contract as in the case of the above-mentioned concession.

Joint venture (JV) is an arrangement, under which the public and private parties share the responsibility, financing, losses and profits as shareholders, by forming a shareholding company so called the SPV for a determined or open-ended period to provide public services. The public and private sector partners can either form a new company or assume joint ownership of an existing company through a sale of shares to the private investors. In a JV, a lot of different tasks are implemented, the distribution of which between the partners can be very different. However, usually the private partner assumes such tasks as construction, operation and maintenance and others which require to ensure life-cycle cost's efficiency, while the public partner is more focused on strategic control and remains with those tasks the aim of which is to provide services rather than to generate profit, or which, due to legal constraints, can be performed solely by the public sector or the public sector has more competence to perform them (Tamosiunas & Zilakauskyte, 2010).

This characteristic is inherited in all forms of cooperation between the public and private entities. For example, the private entity is responsible for tasks related to design, building, maintenance of museum's infrastructure as well as sales of tickets, while the public entity prepares expositions; or the private entity designs, builds, operates and maintains the education infrastructure, while the higher or secondary education is provided by staff of the public sector. For strategic reasons, the public sector prefers to keep control of the entity, particularly if the joint venture company owns the assets. The private sector also wants to be sure that it, managing the day-to-day operations, can have the powers of veto or weighted voting rights on certain issues. To specify responsibilities between the public and private entities, the JV contract may be accompanied by additional contracts (subcontracts), such as concession, OM, etc.

As a weakness of JV, the public authority is both the owner and regulator, which, can lead to a conflict of interests. Therefore, this form requires good

[19] Only the public ownership of assets is allowed in PFI under the legal regulation of Lithuania.

corporate governance, which would not allow meddling in the company's business to achieve political goals. On the other hand, the JV emphasizes relatively one of the highest levels of each entities' integration ensuring the delivery of the public services.

Divestiture is the ultimate level of private engagement in public services' provision, when the public sector abandons the service delivery, transfers ownership of the existing facilities and responsibilities for their future expansion and, in most situations, keeps only a regulatory role in the form of a license granted to the private entity to deliver the service to the public. Without this license, the private entity cannot operate the assets. Since the license can be terminated by the PPA for serious breaches or, on predetermined years notice from the date of agreement for no cause, the PPA has leverage to control the provision of public services. Depending on the needs to control the provision of services, the private investors can acquire partial or full ownership through the stock market or purchase of public assets. However, since the divestiture is partial, it is considered as PPP, while, in the case of transferring 100% of the equity of a state-owned company to private entities (operator, institutional investors, and the like), is considered as full divestiture, also known as, privatization, which are not forms of the PPP. As a form of PPP, it allows the public sector to transfer all responsibilities related to the provision of services, which is an advantage, if their provision can exist without significant public intervention. However, in the conditions of delegating all tasks and transferring partial ownership to a private entity, it is complicated to ensure public interest, which makes the divestiture a rather controversial form of PPP.

All these forms of PPP, depending on the requirements, can be modified. Therefore, there are various hybrid arrangements in practice. This aggravates their classification because individual arrangements under the same name of form, due to various legal and financial considerations as well as mutual agreements may significantly vary. For example, in concessions, the ownership of the newly built assets can be kept by either the public or private entities. As a solution to this issue, there is also a classification related to procurement models, the typologies of which are based on specific tasks, such as Design (D), Build (B), Maintain (M), Operate (O), Own (also O), Finance (F), Transfer (T) and Rehabilitate (R), which the private entity has to perform under the contract. Besides the main ones, there are also Bid (also B), Develop (also D), Lease (L), Upgrade (U), Purchase (P), etc. By using these components, it is possible to construct various schemes of arrangement between the public and private partners. For example, the rather traditional way of IP's implementation described by components Design-Bid-Build would be abbreviated to the simple acronym DBB, while the procurement model focusing on the entire infrastructure's life cycle (such as, e.g. concession) reads as Build-operate-transfer (BOT). An arrangement (e.g. the same concession) where the ownership permanently remains with the private entity would be Build-operate-own (BOO), and if it is transferred back to the state at the end of collaboration period, it would be Build-operate-own-transfer (BOOT). Based on the same logic and considering the variety of components, many schemes of PPP can be constructed accordingly. A list

of PPP schemes found in literature is presented in Appendix 2[20]. Most common in practice are schemes[21] that combine traditional public investment and private sector operation of government-owned asset. Sometimes this arrangement takes the form of operating lease, which can also be considered as PPP, if the private operator has responsibility for the maintenance and improvement of the asset. However, this dissertation does not seek to explicitly exclude any type of possible arrangements of PPP, but rather focuses on attempts to disclose consistency among the different arrangements instead.

Since PPP is considered as an agreement for dividing appropriate tasks between the partners, a detailed classification of schemes can be based on the degree of private involvement in the provision of public infrastructure and services, i.e. depending on the ownership of capital assets, as well as the responsibility for investment and assumption of risks allocation between the public and private partners. Moreover, for the scientific and practical purpose, it is important to determine links between the forms and schemes. Accordingly, Appendix 3 summarizes different forms and schemes of PPP and their positions on the public–private spectrum depending on the scale and scope of private and public responsibility. It does not purport to show all possible structural variations, but the most common usage has been followed.

A variety of forms and schemes of public and private provision allows the public sector to choose the optimal one depending on the circumstances and requirements. Although the conception of PPP in this dissertation is related to the tasks of investment and operation, which have to be performed by the private entity, not all of these arrangements are considered as PPP in different countries[22]. However, this does not mean that, in general, the application of appropriate public–private provision is impossible to apply in practice[23]. Despite the classification, the general tendency is that the more tasks are delegated to the private sector, the less risks are left with the public authority; however, with transferring responsibilities there are also less possibilities for the public authority to control the efficiency of process and the quality of results of service provision. Moreover, the private entity costs every borne risk. This allows concluding that the determination of the optimal form and scheme of PPP has to be a result of VfM assessment, considering various legal, financial, economic and market restrictions as well as potential possibilities.

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[20] Since PPP, due to Lithuanian legal constraints, is defined by characteristics of infrastructure needed to be invested and operated or maintained by the private entity, not all found schemes are considered as PPP or generally applied in the public sector of Lithuania e.g., the form of a design-build-finance-transfer (DBFT) scheme or a financial lease is not a PPP because it does not involve service provision by the private sector.

[21] An analysis of Lithuanian practice disclosed the Design-build-operate-transfer (DBOT) tends to be the most commonly used schemes of PPP in Lithuania.

[22] This is in harmony with the Lithuanian legal system.

[23] Application of appropriate schemes of public–private provision can be limited, due to legal constraints, e.g. in Lithuania, the existing public infrastructure cannot be transferred to a private entity on ownership basis at any time, if it is not privatized.

Accordingly, the choice of an appropriate form and scheme determines the contractual and financing aspects of relationships between all stakeholders in the PPP. To further examine this aspect of PPP, the interest of different stakeholders as well as structuring of PPP are further analyzed in the next section of this dissertation.

1.2.3. Advantages and disadvantages of PPP

Given that the overall advantages of private participation in the public sector has already been analyzed in the previous section of this dissertation, this section focuses on the advantages and disadvantages of PPP as an alternative way of implementing investments in public infrastructure and services. Accordingly, literature is rich in articles addressing pros and cons for the application of PPP. This aspect, under the keywords of advantages and disadvantages, merit, benefits, positive and negative factors of PPP has been analyzed at various levels of depth by many scientists (Akhmetshina & Mustafin, 2015; Andreas, Mong, Bjørberg, & Støre-valen, 2016; Carbonara et al., 2014; Desgrées du Lou, 2012; Gordon et al., 2013; Gouveia & Raposo, 2012; Gudelis & Rozenbergaitė, 2004; Harada & Ogunlan, 2015; Hwang et al., 2013; Liu et al., 2015; Martins et al., 2011; Mota & Moreira, 2015; Poulton & Macartney, 2012; Sambrani, 2014; Sarmento & Renneboog, 2016; Sharma, 2007; Li Yin Shen et al., 2006; Wojewnik-Filipkowska & Trojanowski, 2013). An analysis of their articles disclosed that the main drive for use the PPP is that it allows the public sector to avoid limitation on the public sector budgets. However, the more detailed debate on this and other advantages of PPP are highly complex because the PPP also has particular issues.

Returning to the positive argument for PPP, it is explained that in the case of providing at least a portion of private financing, the public sector is not required to immediately fund all initial capital investments. They can be spread over the life of the PPP contract instead and have to be repaid only when the investment stage is finished (Auriol & Picard, 2013; Liu et al., 2015; Sarmento & Renneboog, 2016; Shaoul, 2011; Shen et al., 2007) (Figure 1.2). This decreases the risk of construction delay for the public sector (Bin Yang et al., 2010; Kokkaew & Wipulanusat, 2014; Li Yin Shen et al., 2006) as well as puts a lower pressure on the annual budget, which enables the public sector to break free from short-term constraints on investments in public infrastructure imposed by insufficient tax revenue and limits of public sector borrowing, and to achieve more results with the same annual budget. Therefore, in PPP against CP, capital investments of the developed infrastructure are either funded by unitary payments (UPs) from the public budgets or paid by direct users, or by using a mix of these two funding ways becomes more financially affordable (Asao et al., 2013; Burke & Demirag, 2015; Khadaroo, 2008; Valila, 2005). This is especially relevant in areas where these constraints are created by artificial rules, such as the Stability and Growth Pact's limitations on budget deficits in the EU (Benito et al., 2008; Morales et al., 2013). If such capital investment financing scheme is not considered as public sector borrowing and can be shown as expenditure of the public budget, there are advantages of PPP which provide the possibility of "off-balance sheet" borrowing, i.e. the PPP is viewed as an

alternative mechanism to address fiscal challenges (Carmona, 2010; Gouveia & Raposo, 2012; Hodges & Mellett, 2012; Moro Visconti, 2014; Sarmento & Renneboog, 2016). This enables the public sector to make or accelerate investments in infrastructure, which otherwise would not have been possible or would have been delayed. Therefore, if, considering budget constraints, public borrowing reaches the limits, the realistic choice is generally not between the PPP and CP of the facility, but between the PPP and no investments at all. Accordingly, there is a frequently-used argument that the PPP allows investing in public infrastructure and services more quickly (Skietrys & Raipa, 2009).

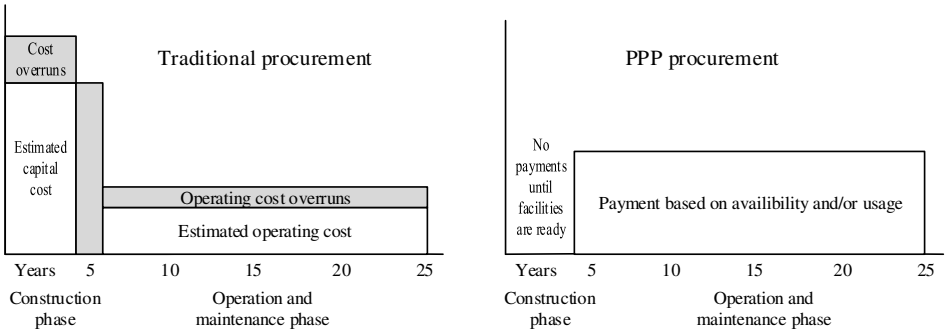

Figure 1.2. Payment profiles for the public sector at different routes of procurements (prepared by the author of this dissertation)

However, there are also negative aspects related to the financial possibilities provided by the PPP. It should be noted that, despite how the future payments from the government to the PPP are going to be recorded in public accounting, they are long-term liabilities, which have an eventual impact on the public budget in much the same way as borrowing and can threaten the sustainability of public finances (Benito et al., 2008; Grubišić Šeba et al., 2014; Morales et al., 2013). Therefore, "off-balance sheet accounting" advantage embeds a potential danger; namely, the temptation to avoid budget constraints, which may lead to a debt overhang, i.e. a condition of the government under which the debt level is so high that it is no longer able to attract more debt, even if the debt conditions are favorable to new investments. This requires attention when relatively small countries enter into large PFI programs, e.g. Portugal and Greece have established many PPP IPs over a short period of time, raising concerns about their affordability, given the future impact on liquidity and even state solvency. Accordingly, this was an argument for changing the rules of public accounting in such way which would not distort the approach of PPP, as e.g. the Eurostat in the EU has tried to do in 2016 by tightening the regulation on accounting of government deficit and debt (Eurostat, 2016). According to Eurostat, public liabilities of the PPP, and PFI, more specifically[24], can be excluded from the government balance sheet of assets and liabilities for statistical treatment, only if all construction, availability and major part of demand risks are

[24] Manual on Government Deficit and Debt (Eurostat, 2016) is applied only for PFIs, however a similar manual is planned for concessions.

transferred to a private entity as well as a number of minor requirements are satisfied. Although these rules still have some practical issues of application, the general tendency to move to more transparent accounting of public liabilities is obvious. Therefore, the so-called advantage of "off-balance sheet" borrowing is decreasingly mentioned in the context of PPP.

Another advantage of PPP is that it allows the public sector to transfer risks to those who are best able to manage them, at the least cost which is a key element of VfM (Alexandersson et al., 2008; Ball, 2011; Galilea & Medda, 2010; Iseki & Houtman, 2012; Jin & Zhang, 2011). Risks related to the design, construction, maintenance, finance, availability, performance, operation, etc. can be transferred to the private sector, which is traditionally believed to be more efficient in their management and, therefore, the costs of provision of infrastructure and services can be lower than if the risks were retained by the public sector. Cruz & Marques (2013) have found that the hospital PFI IPs have a better track record in on-time and on-budget delivery: 76% and 79% for PPP IPs against 30% and 27% for conventionally procured IPs. Similar results are presented by the National Audit Office in the UK (National Audit Office, 2009). According to EIB, 85% of its financed PFI IPs have been delivered within budget, 63% on time or earlier and this proportion increases to 80%, if allowance is made for minor delays (up to four weeks), and 85% in-line with their original specification (Bain, 2009). The example in France shows that in PPP schools on average 15% saving in capital expenditure was achieved compared to the traditionally-procured schools (World Bank, 2013). However, these reports on cost overruns are incomplete and suffer from inconsistencies in respect of PPP's definition, described in the previous sections, which also similarly challenges the process of data collection and analysis. Therefore, the reality of lower costs through risk transfer and private sector efficiency in the PPP remains disputed (Clark & Root, 1999).

Regarding risk transfer, despite of how risks are allocated between the partners, the public sector, having to ensure the provision of public infrastructure and services, remains the last guarantor who assumes and covers all risks in the case of PPP's collapse. If the PPP goes wrong, the private investors may lose their investments but they have no obligation to put further money in to rescue the IP. Therefore, it is likely that the public sector, due to its responsibility to provide the appropriate functions, will incur extra costs to maintain the public services. This reveals that risk transfer fails anyway to this extent, therefore the PPP is criticized for the privatization of profits and socializing losses. Moreover, it is complicated to quantify the transferred risks, which makes the determination of adequate reward and guarantees to the private party a complex process (Carbonara et al., 2014; Du & Li, 2008; Grimsey & Lewis, 2004; Jin & Zhang, 2011).

Regarding the efficiency of the private sector, there are practical examples demonstrating that many PPPs do not always achieve these benefits, which discloses that private participation does not immediately mean lower total costs (Ahmed & Ali, 2006; Benito et al., 2008; Clark & Root, 1999; Daito & Gifford, 2014; Gordon et al., 2013). For example, according to Carmona (2010), road construction costs are 24% higher in a PPP in comparison to CP. On another hand, this difference is of

similar scale as there are cost overruns that can be observed under CP. The author of this dissertation has found that among the IPs implemented in a traditional way in Lithuania, the investment budget was overrun on average by a quarter (Jasiukevicius & Vasiliauskaite, 2015a). Therefore, higher construction costs under bundling could reflect a price that the public sector is ready to pay for avoiding time and possible additional cost overruns.

Attempts to achieve lower costs are aggravated due to the fact that private financing for PPP costs more than if an IP was procured in the public sector and financed with public borrowing, which is one of the most significant disadvantages of PPP (Alexandersson et al., 2008; Mota & Moreira, 2015). Even for those PPPs where revenues are derived from regular payments from the public sector, the cost of capital, due to greater risks of lenders, are typically around 2–4% higher than in the case of public funding (Yescombe, 2007)[25]. This allows arguing that the PPAs have to provide guaranties to lenders to make the costs of capital in the PPP lower and competitive against the capital cost of pure public financing, which increases the contingent liabilities of the public sector.

In order to overcome higher cost of capital in the PPP, the private entity has to elaborate all specific skills and experience as well as provide innovation allowing the public sector to get benefits which are not available to the public sector and, therefore, are the key features and advantages of PPP (Ahmed & Ali, 2006; Jefferies, 2006; Silvestre, 2012; Wang, 2014; Willoughby, 2013), since a procurer, by calling the private bids, specifies outputs rather than inputs, i.e. what is required in respect of facilities and services, but not how the service has to be delivered (Ball, 2011; Desgrées du Lou, 2012; Kurniawan et al., 2015; Moro Visconti, 2014; Parker & Hartley, 2003; Reeves, 2005; Felix; Villalba-Romero & Liyanage, 2016; Wang, 2014). Such output specifications provide greater flexibility for the private entity to come up with innovative solutions. Regarding innovation coming from the private sector, an important aspect is that doing something different or innovative inevitably involves risk, therefore the natural behavior is to avoid taking such risks, unless there is an incentive to do so. The public sector, as being a natural monopolist in many sectors, typically prefers to use what has worked in the past as this involves less risk.

However, for the private entities which provide bids, the use of innovation can make the difference between securing or losing a PPP contract. In this case, the innovations are heavily incentivized. Therefore, PPPs are more likely to generate new or improved ways of delivering public infrastructure and services, which may result in a better quality of infrastructure and services or/and their more efficient delivery that ensures VfM (Khadaroo, 2008; Xueqing Zhang & Chen, 2013). This is also supported by the fact that the private entity is typically engaged to do several consistent tasks, therefore they have strong incentives to focus on the lifetime of the asset, thus the least whole-life costing can be applied, which is also one of the most important elements of VfM for PPPs (Fernandes et al., 2015; Martimort & Pouyet, 2008; Maskin & Tirole, 2008; Wang, 2014). Moreover, the PPP contract is agreed

[25] The tendency is also observed from practical experience of the author of this dissertation.

with one entity or consortium for all transferred tasks, therefore the results of infrastructure and services provision become easier to manage and control; moreover, one contract provides more transparency on the final responsibilities between the entities participating in the implementation of the IP (Sarmento & Renneboog, 2016). Finally, among other advantages of PPP, there is an argument that in some types of PPP, such as concessions, partially PFI, etc. the SPV can be allowed to generate additional revenues from commercial services when the infrastructure is foreseen to be not fully utilized by the demand of the public sector, which may help to reduce payments form the public sector and/or price of the main services for their direct users, thus also improving VfM to the public sector.

The negative factors related to the same features of PPP are that it requires strong procurement skills enabling the PPA to prepare conditions for the private entity encouraging its proper incentives. This requires to accumulate specific competence, which determines higher transaction costs of PPP in comparison to those borne by the public sector for CP (Acerete et al., 2011; De Clerck & Demeulemeester, 2015; Mu et al., 2011; Xu et al., 2012). They are also high for the private sector. According to Schepper et al., (2014), increasing reluctance from the private partners to engage in PPP-bidding is observed. Up-front costs that PPP bidders make in the pre-contractual stage are considered too high compared to the bidding chances, and may result in less bidders in the future. Moreover, long-term agreements with private entities reduce the flexibility of the public sector in the management of transferred public services during the period of contract, which requires to anticipate long-term requirements for infrastructure and services for many years, which is usually not easy (Evenhuis & Vickerman, 2010; Mota & Moreira, 2015).

Table 1.2 below summarizes the above-mentioned key advantages and disadvantages of PPP against the CP from the perspective of the public sector. Many arguments from both sides show that the PPP does not mean only benefits for the public sector. Therefore, its application must be well-reasoned, requiring complex assessment where both the advantages and disadvantages of PPP have to be considered.

From the perspective of the private sector, the PPP as compared to CP provides a more stable, long-term contract, based on which the private entity is less dependent on the public sector's annual budget. Since the public sector specifies only the outputs and applies proper incentive mechanism, the private entity has flexibility in determining the specifications of how the final products or services should be provided, which, through the incentives for good performance and delivery of quality services, allow maximizing the gains. Moreover, in the PPP, there is also a possibility to generate additional revenues from the third parties (Wojewnik-Filipkowska & Trojanowski, 2013). The negative factors of PPP are related to the limitation of profitability and higher participation costs. However, if the conditions of PPP do not allow the private entity to get sufficient profit, it simply does not provide a bid or can refuse to go into partnership at any moment of procurement. Since the PPP is primarily considered as an alternative way of implementing investments in public infrastructure and services for the public sector,

pros and cons of PPP from the perspective of the private sector are not analyzed in this dissertation in more detail.

Table 1.2. The main advantages and disadvantages of the PPP against the CP (prepared according to the scientists mentioned in this section of the dissertation)

PPP advantages	PPP disadvantages
Avoidance of initial investment cost **Reasons for advantages:** Better affordability for the public sector	Affordability concerns debt overhang **Reasons for disadvantages:** Reduces fiscal space for future years
Off-balance sheet debt **Reasons for advantages:** Increases fiscal space in the investment years	Future payments may threaten public finance sustainability; Liabilities may not be known until payments arrive; Government guarantees represent future liabilities **Reasons for disadvantages:** Low budget transparency
Acceleration of infrastructure development **Reasons for advantages:** Economic and social externalities from new infrastructure	VfM is complex and difficult to measure; VfM is based mainly on risk transfer; Risk is a complex process; Lack of public sector's experience or appropriate skills **Reasons for disadvantages:** It is not clear that PPPs are more efficient than alternative models
Risk transfer to the private sector **Reasons for advantages:** Risks allocated to the party which is able to manage them at the lowest costs.	Lack of clear public policies and objectives; PPP planning is complex **Reasons for disadvantages:** Long-term and complex contracts
Higher service quality **Reasons for advantages:** More benefits for users through higher value of provided services	High percentage of renegotiations **Reasons for disadvantages:** Incomplete contracts lead to little flexibility and remote renegotiations; Asymmetric information reducing competition and efficiency
Increased innovation in service provision **Reasons for advantages:** Better accessibility to innovation, specific skills and competences	Higher transaction costs; **Reasons for disadvantages:** Decrease VfM
Considering full lifetime of assets **Reasons for advantages:** More efficient use of assets	Higher cost of capital; Higher participation costs **Reasons for disadvantages:** Increases the costs of service provision
Greater operating efficiency; Reduction of total IP costs and more efficient use of public money; Achievement of VfM **Reasons for advantages:** Lower total cost of provided services; Better use of public resources	
Public sector focuses on strategy, rather than operational tasks **Reasons for advantages:** Enables public managers to address key issues and not disperse with non-significant problems	

In conclusion, the PPP, if properly structured, can provide many benefits; however, usually not without compromises. Therefore, the public sector has to make a well-grounded decision for the expediency of PPP's application in every particular IP. This requires to properly assess whether the PPP can optimize investments in public infrastructure.

To evaluate the possibilities of PPP to optimize investments in public infrastructure, it is important to construct a rational PPP option as the best alternative for comparison with the CP option. Theoretical aspects of structuring PPP are analyzed in the following section of this dissertation.

1.2.4. Structuring of PPP

There are two main entities in the PPPs: the public sector entity, which organizes procurement, and the private sector entity, which is delegated to perform certain tasks on behalf of the public sector. Both parties usually consist of a group of stakeholders. The public entity can be a single PPA or a partnership between several public entities of the same or different administration levels, e.g. municipality and national government, which may also represent the interests of other public sector institutions. While the private entity is typically a consortium, which, depending on the scheme of PPP, may consist of a bank/financial institution and some combination of construction, maintenance and facilities management and operation companies organized as an SPV to run the IP (Chowdhury, Chen, & Tiong, 2012; Ng & Loosemore, 2007; Sanderson, 2012; Shaoul, 2005; Li Yin Shen et al., 2006; Zangoueinezhad & Azar, 2014). As discussed in Section 1.1.2., both public and private parties have their own interests and expectations within the PPP, among which an equilibrium has to be achieved in order to sign the PPP agreement. This requires a rational structure of PPP, i.e. as it is analyzed be analyzed in Section 1.3.3., much of the success of PPPs depends on how the responsibilities and risks are allocated and shared between the partners. The PPA, having the results of an ex-ante VfM assessment, defines the overall structure of PPP as well as the fundamental conditions of cooperation with the private entity before launching procurement. However, only negotiation with the elected private entity allows reaching a final bargaining situation, when both parties have the possibility of concluding a mutually beneficial agreement, which determines the final conditions of collaboration in the PPP (Boyer & Newcomer, 2015; Cheah & Liu, 2006; Huang & Chou, 2006; Kurniawan et al., 2015; Sarmento & Renneboog, 2016; Shen et al., 2007; Xu et al., 2012; Xueqing Zhang, 2011).

Typically, when structuring the PPP, depending on the transfer of tasks to the private entity, the PPA sets quality standards and capacity requirements of service and infrastructure delivered to the customers. In order to encourage proper incentives for the private entity, the PPA determines the appropriate mechanism of payments and compensation, including various penalties, if the availability, adequate safety levels, and performance standards of the infrastructure are not maintained, or rescission of the contract, if the SPV does not manage the infrastructure and provides services inappropriately (Burke & Demirag, 2015). To make the PPP financially viable and reduce the downside of the financial failure of high-risk investments to make the IP attractive, the PPA may provide at least a portion of equity and subordinated debt or, on a more frequent occasion, subsidies in the forms of investment grants, guarantees, tax reduction and other contribution (Chen et al., 2012). It is also a frequent practice to compensate at least a portion of equity investments in case of the failure of the SPV. This is based on the conception that if

the business financial model does not work in practice, the PPA, as in the CP, should reward the private entity for the built infrastructure, which accrues to the ownership of the public sector. At the same time, to ensure public interest, a mixture of means not allowing the private entity to get unreasonably high profit in the monopolistic market is also applied or it would not be compensated more than the alternative costs of infrastructure development. Besides, under the PPP contract, the PPA also predetermines the aspects of risk allocation, price variations, flexibility and renegotiation, contract duration, subcontracting, and a few miscellaneous issues, such as the procedures of dispute resolution (Gordon et al., 2013). For specific tasks, especially in the planning stage and at the public bidding, the PPA may also involve external financial advisers, lawyers, and other types of consultants as well as ask advice and contribution from the local PPP unit, if such institution is established in the country. Finally, in case of the institutional PPP, the PPA may also participate in the management of the SPV. However, in most of the cases, it concentrates on strategic objectives and controls the results of services and infrastructure provided by the private entity.

Meanwhile, under the structure of PPP, the private entity is typically engaged to provide the services of technical assistance or/and directly for the customers. Obligation to perform other tasks depends on the applied scheme of PPP, i.e. a combination of the delegated tasks with the associated responsibilities and risks depends solely on the PPA's requirements reasoned by the results of ex-ante VfM assessment. Usually, such tasks as design, construction, maintenance, etc. are passed on to the subcontractors, who also assume the management of associated risks under subcontractor agreements. In any case, the private entity is required to insure assets and performance against various negative impacts. Depending on the scheme of PPP, the private entity can be asked to ensure all or a portion of financing, which is usually a mix of equity, subordinated debt and senior debt. Investors provide equity, usually between 7%–15% of the IP financing requirement (HM Treasury, 2011), and subordinated debt. Other debt financing, up to 93% of total financing, may be obtained either through a bank debt or bonds, the first of which is more prevalent in practice, while the attractiveness of the second one increases under the conditions of a financial crisis, when commercial bank debt has become more difficult to secure and lending terms have deteriorated significantly, affecting the bankability and VfM of PPP IPs (EPEC, 2012).

In any case, to reduce the cost of capital, as high as possible financial leverage is sought. However, when bank debt financing is used, a lender approves the maximum amount of debt for an IP, usually up to 60–90% of total capital investments, and drawdowns occur over the construction period until the planned maximum is reached (Fernandes et al., 2015; Khmel & Zhao, 2015; Sarmento & Renneboog, 2016). Interest is accrued periodically on the outstanding balance as the debt is drawdown over the construction period, with a commitment fee applied to the unused portion. When construction is completed and the developed assets are available for the users, the PPA begins payments to the private partner or/and allows the private entity to charge users for the delivered services, which allows the debt to be repaid via fixed payments of principal and interest. All conditions of the provided

loans, such as pricing, tenors, loan volumes, etc. are defined in a tripartite loan agreement between the investors, the lenders and the PPA, the signing of which refers to the financial closure of PPP. Under this agreement, the banks are provided with step-in rights allowing them to take control of the infrastructure project, if the SPV becomes insolvent. It is also ensured that cash flow (CF) after operating profit is used firstly for debt service and then to pay distributions to the investors. Moreover, bank loans are usually secured via a government-backed revenue stream, therefore in the case of failure of the SPV, the PPA has to repay the banks, which significantly reduces the financing risk for the banks. If the return on equity or revenue stays within the predetermined bounds, CFs after debt repayment are left for equity return. Otherwise, revenue or profit sharing with the public sector or other mechanisms restraining the profitability of the private entity are applied.

Figure 1.3 generalizes the above-described relationships between different shareholders and shows the main contractual and financing building blocks for a typically developed PPP. The arrows show the direction of CFs or influence, while the solid and dotted lines represent elements which are constant or potentially possible, depending on the PPP forms, schemes and financial structure of IP, respectively. The key elements in the structure of PPP are:

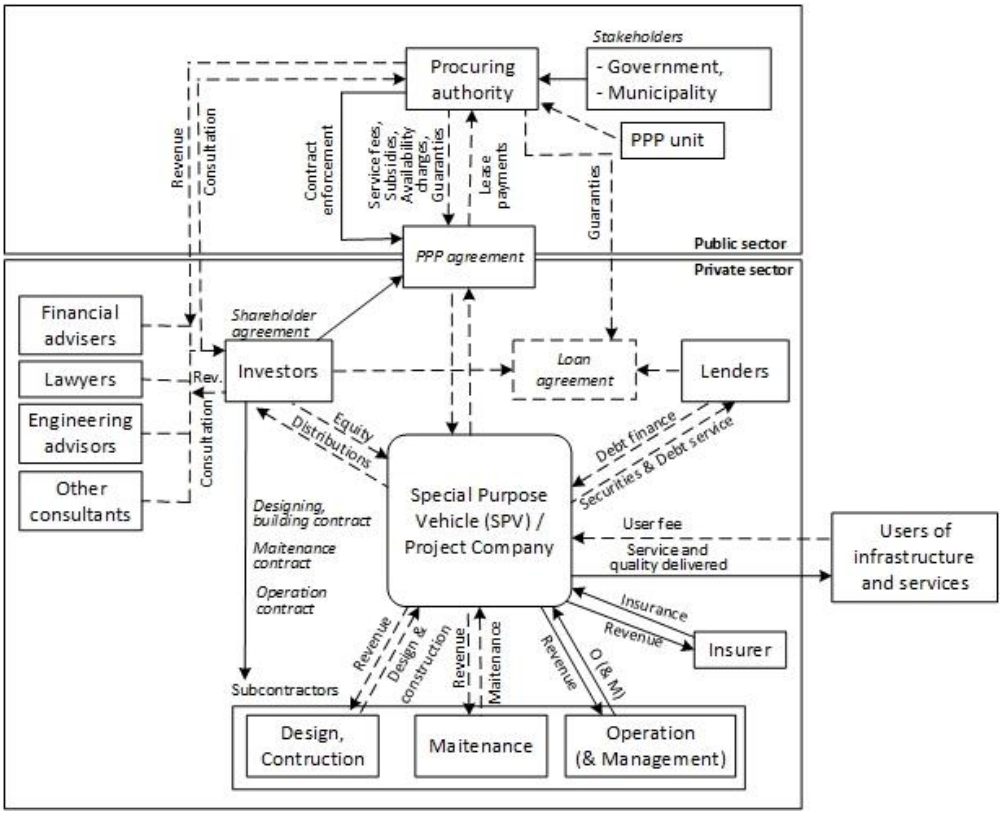

Figure 1.3 Generalized PPP transaction and contractual structure (prepared by the author of this dissertation)

- PPP agreement signed between the investors and the PPA, under which the responsibilities and allocated risks are shared between the partners as well as the mechanism of payment, pricing and compensation are determined for the infrastructure or/and service provided by the private entity or infrastructure provided by the public sector in a case of lease and similar arrangements.
- A project company, the so-called SPV, which runs the IP and is usually owned only by private investors; however, under the institutional basis, the ownership can also be shared between the private investors and the PPA.
- Financing for IP's capital costs through shareholder equity and project finance debt. Debt financing may be provided by commercial and development banks, pension funds or other institutional financiers with which the investors and PPA sign a trilateral loan financing agreement.
- Operating subcontracts, under which the operation subcontractors provide services or/and manage infrastructure for a fixed period. While other subcontracts related to the design, construction and maintenance, etc. of infrastructure depend on a share of risk transferring to the private entity.

Beside the mentioned elements, the diagram above shows that the structure of PPP may also include services of insurance, external advisors from both the private entities, such as financial, engineering advisors, lawyers, etc. and the public entity, such as the national PPP unit as well as the participation of the undertakers, controllers and auditors, whose functions are related to the insurance of public interest. The particular structure of PPP depends on the specific PPA's requirements and the results of procurement, i.e. the elected participant determines which structure of entities represents the private party in the PPP.

Considering the above-mentioned aspects, it is obvious that the structuring of PPP may be a challenging process. However, a well-structured PPP can also provide many advantages, which have been analyzed in Section 1.2.3. Therefore, since the PPP is considered as a possibility to optimize investments in public infrastructure, it is important to analyze the aspects related to the assessment of these possibilities. Accordingly, the theoretical aspects of the of PPP's possibilities to optimize investments in public infrastructure are analyzed.

1.3. Theoretical aspects of VfM assessment

Since PPP is one of the ways to implement investments in public infrastructure, the expediency of its application requires to be properly assessed: PPP proposals can be justified to proceed, if they are proven as a better delivery option against CP. VfM is the main justification for choosing public or private provision for delivering public infrastructure and services (Liu et al., 2015; Moro Visconti, 2014; Shaoul, 2005; Wang, 2014). Since there is no single more important exercise than carrying out a transparent "cost comparator" for a government, in many countries VfM assessment is used as the main decision-making tool not only to support the decisions on whether to deliver public infrastructure IP through PPP or other CP

means, but also for the choice among PPP bids for a particular IP as well as other selections within the context of public investment (Burger & Hawkesworth, 2011).

In the context of PPP, the general conception and objectives of VfM assessment are widely acknowledged: it is a comparison of total cost of IP's delivery options in a structured manner to identify the best one delivered by traditional government means versus the private sector means. However, there is no a unique approach to VfM assessment as well as its precise objectives and therefore related methodologies. The existing differences disclose that the VfM assessment within a context of PPP is subject to considerable issues both in the academic and political debates.

Accordingly, this section of the dissertation is primarily committed to an analysis of VfM conception within the context of PPP. Further, descriptive and comparative analyses of different approaches of VfM are performed. Finally, a review of factors increasing the VfM for the public sector is provided.

1.3.1. The conception of VfM assessment

VfM is a widely-used term that has intuitive plausibility; however, its substantive meaning is ambiguous. In the context of public finance, it is associated with general objectives of the public sector entities, the so-called the three *E*s: economy, efficiency and effectiveness (Shaoul, 2005). Due to a variety of conceptual and methodological reasons, the focus is on economy, indicating the price paid for provided service at best value, taking the price and quality into account, rather than the remaining concepts discussed in the previous sections of this dissertation. Its meaning in the context of PPP is also no more precise and fundamentally focused on the disclosure of net positive gain to society in respect of cost of inputs, allocation of efforts and achievement of the goals which are greater than they could be achieved through any other alternative procurement route. In this case, the private option beside pure public provision is considered additionally.

As a concept, VfM generally emphasizes the objective to capture the best proportionality between value and cost. This discloses its relative nature, i.e. knowing the VfM of a particular option in itself does not take full meaning, if there are no comparative options (Ball, 2011). Accordingly, in the context of PPP, where the concept of VfM is further analyzed, VfM can be gauged and realized only by comparing values and costs to society, when the public authorities carry out IPs in a traditional way to the benefits and costs of developing otherwise similar IPs using the PPP. It is rational to compare the best of both CP and PPP options. Here, cost usually means whole-life costs of the IP to deliver value for the users, including the costs of managing the associated risks in doing so. While value comprises the quality and quantity of service provided for users or the performance level over the length of the same IP.

Since both the value and cost are included in the comparison, there it is logical to assume that the cheapest option may not necessarily be the best option. Accordingly, the best VfM is considered as the most advantageous combination of value and cost to meet users' requirements (Jackson, 2012; Zangoueinezhad & Azar, 2014). However, since, in practice, a constant quality of infrastructure and services

or the same operational level at least satisfying the minimum performance requirements is mostly assumed (FWHA, 2012), the comparison is focused not on the CBA but on the difference between expenditures on public service provision by the public sector using conventional methods of provision versus the private sector through PPP (Harada & Ogunlan, 2015). Therefore, although the provision of higher-quality services, including such intrinsic benefits as earlier service delivery, avoidance of damage to society, etc., with the same expenditure also conceptually fits the stipulation of VfM increase, VfM is generally based on expenditure reduction. Therefore, VfM assessment is often considered as a systemic comparison of whole-life cost of financing and delivering an infrastructure IPs by traditional government's means versus private sector's means.

As a result, VfM is usually measured using the concept of net present costs (NPC), which is a variant of the net present value (NPV) technique developed in the 1950s (Fernandes et al., 2015; Shaoul, 2005). According to the general practice, the standard investment appraisal consists of a comparison of discounted life-cycle costs (NPC) of IP, financed under CP methods known as the PSC, with the NPC of the IP procured as the PPP (Gouveia & Raposo, 2012). Here, the novel and herewith the most controversial feature of the technique is that, as well as the expected financial costs, the costs of the risks associated with the appropriate schemes of PPP are also included. In the PSC, all risks are entirely assumed by the public sector, while in contracting the PPP at least a part of risks, depending on the scheme, are transferred to the private sector, respectively (Martins et al., 2011). Based on the NPV rule, the investments with the highest NPV are preferred as maximizing wealth for society, therefore the option with the lowest NPC is selected as yielding the greatest financial benefit. VfM is calculated as the difference between NPC of the CP option and the PPP option. If NPC of the PPP option is lower than PSC, then it delivers VfM and, therefore, the PPP route can be approved.

The above-provided general principles of VfM assessment technique discloses that the PSC is one of the key parameters allowing the PPA to decide for expediency of PPP adoption. Through comparison with the outcome of competitive bidding process, it, as a ceiling on private firms' bids, enables to determine whether there is an advantage in establishing a PPP by providing an aggregate estimate of the economic advantages or disadvantages of IP considered to be implemented as the PPP. The lower PSC is, the higher pressure is on bids of the private firms to minimize costs as well as the lower possibilities are to maximize the gains from using PPPs that can be a significant issue, if the ceiling, e.g. due to optimistic bias is mistakenly determined below the efficiency level of the private sector. While the higher PSC gives more space for the PPP to be economically justified and socially desirable which becomes especially relevant for the PPA to move ahead with PPP in the cases of IP not being financially affordable as a CP option or/and if this can be done off-balance. Although both of these marginal cases are examples of strategic misrepresentation, they, disclosing a central role of PSC, allow arguing that the situations where the PPAs introduce biases pushing them below or above the right value cannot be refused. Moreover, the assumptions used in the assessment, due to the complexity of IP's structure, insufficient or unreliable available data, difficulties

in dealing with uncertainty and predicting IP's input variables, ranging from the specialized types of labor to energy and raw materials, the lists of which can be quite long and it may not be obvious what the relevant market prices are, or what the right amounts should be for some of these inputs, even due to the optimism bias, are likely to be subjective (Gouveia & Raposo, 2012; Khadaroo, 2008; Moro Visconti, 2014), and since usually a long reference period of 20–30 years is used, even their small changes highly effect the final VfM analysis. Therefore, it is obvious that, in practice, the estimates of the PSCs can easily become a subject of controversy with accusations of being biased and not transparent enough. This determines the requirement for solutions, which could increase the openness and transparency of the public commitment to optimizing VfM.

Many scientists, such as Ball (2011), de Jong et al. (2010), English & Guthrie (2003); Gouveia & Raposo (2012), Grimsey & Lewis (2005), Liu et al. (2015) have analyzed the issues related to PSC and, herewith, VfM assessment, respectively. They argue that a major issue with PSC is that if the CP scheme is not financially affordable, it becomes a hypothetical scheme rather than an actual set of costs from a comparative scheme. Fernandes et al., (2015) claim that, in most cases, the PPP is the "only game in town". As a result, project promoters have real incentives to achieve a positive VfM, therefore the PSC can be manipulated to show "whatever its users require it to show". This, as the following aspects also disclose, creates an in-built bias in favor of PPP.

Another point of criticism is that while in the feasibility stage the VFM analysis is traditionally based on a comparison of identical IPs, which differ only in respects of financing, risk allocation, etc. However, bids can differ substantially depending on received approval, because of different requirements in terms of higher taxation, additional works, higher quality standards, etc. for the private entity (Desgrées du Lou, 2012; Fernandes et al., 2015; Khadaroo, 2008). There is also a critique regarding PSC that its calculation is based on the assumption that the costs of public sector investment are met in the year when they occur, ignoring the fact that the public sector can spread costs over time through financing. Since the discounting methodology favors options which defer expenditure over those which have high costs in the beginning of the period, it creates an artificial advantage for PPP options. However, the loan-financed public sector option can also have a similar payment profile as in the case of PPP, while bond-financing allows principal payment to be deferred until the date of maturity which makes it lower from the perspective of NPV. This allows arguing that since the VfM assessment is based on a comparison of public sector option's costs, where their actual reimbursement differ from the records of accounting, and actual expenditures in the PPP option, there is an inherent advantage for PPP.

In literature, beside the above-mentioned critiques to PSC, the main disputes regarding the assumptions used in the VfM assessment are concerned with the following aspects: application of discounted CFs technique as well as determination of the appropriate FDR (Ball, 2011; Grimsey & Lewis, 2004; Khadaroo, 2008; Moro Visconti, 2014; Shaoul, 2005), risk transfer and allocation between the partners,

competitive neutrality (CN), NFBs, expediency for the involvement of additional transactional costs of PPP. The arguments of both sides are further discussed.

Regarding the *discounted CF technique*, the main arguments against its application is that NPV, as a technique for evaluating investment proposals reflects the degree to which cash inflows or revenue equals or exceeds the amount of investment capital also considered as the opportunity cost required to fund it and, therefore, is applied to maximize shareholders or owners' wealth. Thus, its use in the public sector implies that the public interest is restricted to that of a shareholder, despite the fact that most of public sector organizations are not wealth maximisers in a financial sense (Gordon et al., 2013; Marcelin & Mathur, 2014; Martins et al., 2011; Maskin & Tirole, 2008; Müller & Turner, 2005; Shaoul, 2005; Wright et al., 2001). Moreover, the discounting concept is more rational where investment opportunity instantly disappears, if not immediately undertaken. While, in practice, usually there is a time period over which the investment can be undertaken. On the other hand, each of these procurement options, as presented in Section 1.2.3., has different expenditure profile over time. Therefore, discounting plays an important role putting them on a comparable basis that is in favor of the NPV technique. Based on this argument, discounting is a dominant technique in literature in the context of VfM. However, although the NPV approach is widely used, it is by no means used as the sole criterion – nominal CFs remain important estimates when the affordability of PPP is analyzed.

Since the discounting procedure is applied, a crucial aspect of its methodology is *setting an appropriate FDR* used to reflect time preference in the VfM assessment. The FDR refers to the interest rate by which future cashflows (CFs) need to be reduced to express them in today's current value. Beside the time value of money, it also reflects the risk or uncertainty inherent in future CFs: the greater the uncertainty of future CFs, the higher the discount rate. Since the FDR fundamentally effect the NPV of an option, the choice of FDR can have a heavy influence on which option appears to be more attractive in respect of cost and, herewith, the final results of VfM analysis. Therefore, the determination of FDR attracts much consideration from both the academicians and the practitioners. However, the review of a number of scientific articles (Grimsey & Lewis, 2004; Shaoul, 2005) as well as the guides (EPEC, 2015b; European Commission, 2014b; FWHA, 2012; Infrastructure Australia, 2008) reviewing the current practices in different countries allow arguing that there is no consensus on the methodology for calculating FDR.

The main debates focus on questions of whether and to what extent the corporate finance valuation theory can be applicable in the context of public investment. A key aspect within the debate is whether the assumption to equate FDR to market information on the cost of capital, which also reflects investment risk, may be considered as a superior to any other basis for assumptions to derive the FDR. The argument in favor of applying this valuation approach is based on the assumption that actual cost of financing for the government is not the correct basis for discounting because this is not sufficiently accurate and does not reflect actual opportunity cost of capital (Hanaoka & Palapus, 2012), while the best alternative

investment should, in principle, produce higher earnings than the interest rate paid on public or private loans.

On the other hand, as discussed previously, the public sector usually is not a profit maximizer and from the financial perspective mostly seeks only to cover debt/loan obligations that supports the approach for FDR to be closer to the public sector's average borrowing rate rather than opportunity cost. From this approach, the FDR can be equated to one of three reference rates (EPEC, 2015b): 1) the standard borrowing rate of the PPA for a loan, whose maturity would be equal to the PPP project's life; 2) the approximate average loan life, which in the 25-year IP typically is between 10 and 15 years, rate[26], and; 3) the rate of PPP IP loan maturity, which is linked to equivalent maturities in the market. This discloses the possibility to choose accordingly.

If the corporate finance valuation is accepted as applicable to the public sector, a subsequent questionable aspect is whether, in order to reflect IPs risks premium in the results, this valuation approach should be followed in setting the FDR or/and reflected in the adjustment of the IP's CFs (Khadaroo, 2008; Martins et al., 2011; Dimitrios a. Tsamboulas & Kapros, 2003; Xu et al., 2012). In the first case, the expected CFs are estimated across all scenarios, multiplying the probabilities of each scenario by the likelihood of that scenario unfolding, and then discounting those CFs by using the risk-adjusted FDR. Here, the choice of an appropriate FDR depends on the chosen perspective: narrower financial or wider social-economic, from which the VfM assessment is performed (Shaoul, 2005). From the financial one, the FDR equates to the cost of borrowing for the PPA during the period of PPP. While, from the socio-economic perspective, the FDR is closer to the cost of private capital for the IP, which, in comparison with the financial one, includes a risk premium to the extent that risks are not otherwise reflected in the adjustments of IP's CFs. In the second case, the risk adjustment process through the replacement of the uncertain expected CFs with the certainty equivalent CFs is akin to the one to adjust FDRs, however, those certainty equivalent CFs are discounted at a risk-free rate. Both approaches are alternative to adjusting for risk, if the risk premiums from risk and return models to compute certainty equivalents and the value obtained from both approaches is the same. However, each of these approaches to estimating risk adjusted value of an IP also have some advantages and associated problems.

When risk is adjusted through such risk-adjusted FDR methods as the capital asset pricing model (CAPM), the arbitrage pricing model or the WACC etc., the effect is transparent and can be easily estimated by adding IP's specific risk premium to the risk-free rate (Grimsey & Lewis, 2005; Macário, 2010b). If there is a requirement to assess the results at a different level of risk, the FDR can be changed quickly and comfortably. To make the discounting process as simple as possible, the practice to use the FDR which is fixed for a certain period, usually from five to ten years, is also observed. This special case was found in the UK, where the FDR was equal to SDR which is the same used in the CBA, and the calculation of which was based on the social time preference rate approach (HM Treasury, 2006, 2011, 2012).

[26] The average loan life period observed in practice of PPP implementation in Lithuania.

This also could be equal to social opportunity cost of capital or based on weighted average cost of capital approach or shadow price of capital approach, which are analyzed by Freeman & Groom 2016; Kazlauskienė (2015) Kossova & Sheluntcova, 2016). However, the STPR approach, as a review of literature has disclosed (Evans, 2009; Kazlauskienė, 2015; Moszoro, 2010), is prevailing due to its mathematical simplicity and availability of data.

However, although the use of risk-adjusted FDRs in computing value is widespread in practice, there are also some unresolved issues in their usage. First, although most of PPPs consist of several periods when the exposure for risk is different, e.g. construction and operation, also despite the fact that actual cost of capital is constantly changing, CFs are usually discounted at single period FDR, compounded over time and, therefore, are not accurate at a particular moment (Zawawi et al., 2014). Second, in most discounted CF valuations all CFs are assumed to be equally exposed to risks and, therefore, are discounted at the same rate. But this assumption is not always true; e.g., the level of uncertainty related to the CFs of revenues and variable operating expenses is higher than fixed operating expenses, such as pre-committed payments. Therefore, there is a question of whether these types of CFs could be discounted at different risk-adjusted FDRs depending on their riskiness and whether the risk differences are large enough to make a difference (Brandao & Saraiva, 2008). Finally, since riskier assets are assessed by increasing FDR, this presupposes that the CFs are positive. Therefore, in the case of CFs being negative, e.g. in the construction period, the higher FDR has a perverse impact of reducing their present value. As a solution, negative CFs could be separately discounted at a lower rate e.g. risk-free rate. However, this would also determine the internal inconsistency in how the CFs deal with risk (Damodaran, 2007).

The advantages of certainty equivalent CFs' approach are that it counts only those CFs which are "safe" from risk, therefore, it allows calculating a guaranteed return that someone would accept rather than taking a chance on a higher, but uncertain, return. In comparison with the risk-adjusted FDR, certainty equivalent approach provides more precise estimates of value when risk-free rates and risk premiums change from time period to time period (Brandao & Saraiva, 2008; Choudhry, 2015). Moreover, as distinct from the previous approach, the certainty equivalents are computed from utilities functions, and when they are negative, they become more negative as the risk increases, which is more consistent with intuition. This approach is also preferable in the cases where risks occur infrequently but can have a large impact on values, because it may be easier to adjust the expected CFs than determine an appropriate risk-adjusted FDR. This approach also harmonizes better with cases where the public sector is not a profit maximizer, as it was discussed in Section 1.1.1. However, a disadvantage of this approach is that it is problematic to convert uncertain expected CFs into guaranteed certainty equivalents. Despite a number of models developed to get certainty equivalent CFs, such as utility models, risk and return models, CF "haircut" models, etc., their estimation remains a challenge (Damodaran, 2007).

For the VfM assessment, in most of cases, the same FDR is applied to the CFs of both the CP and PPP options[27]. However, depending on the above-presented assumptions about the perspective of the VfM assessment, the ways risk is reflected and the approach applied as a basis to reflect relevant risks and time preference, there are many different approaches used to determine the FDR for VfM assessment. The most significant methodological differences are mostly observed between separate countries (EPEC, 2015b). Accordingly, the differences among methodologies of VfM assessment in different countries regarding aspects of FDR application and others are presented in the following sections of this dissertation.

Since the *optimal allocation of risk* is one of the key objectives of all PPPs[28], it is important to determine the appropriate value of retained risk needed to be included in the PPP option. For this purpose, initially all the risks associated with appropriate tasks such as design, construction, maintenance, operation, finance, etc. over the life-cycle of IP must be identified (Ernest Effah; Ameyaw & Chan, 2015; Ernest Effah Ameyaw & Chan, 2013; Bowers & Khorakian, 2014; Hwang et al., 2013; Martins et al., 2011; Wojewnik-Filipkowska & Trojanowski, 2013) as well as their analysis in terms of likely impact and probability of occurrence has to be performed (Demirag et al., 2011; Kokkaew & Wipulanusat, 2014; Lehtiranta, 2014; Dimitrios a. Tsamboulas & Kapros, 2003). Once this is done, risk needs to be allocated between the PPA and the bidder. Each transfer of risk to the private sector should be considered from the VfM perspective. Therefore, VfM, as a relative concept, requires the comparison of total cost of both PSC and various PPP options, where the PPP option with the best VfM could be found through the modelling of different risk transfer scenarios. For comparison, PSC conceptually includes full risk adjustment which helps to get an overall picture of the IP's cost, if it was implemented under CP. While in the PPP it is necessary to deduct the risks transferred to the private subject, retaining only the risk added to the PPP cost. Here, the more risk is transferred, the more expensive the PSC becomes relative to the PPP option. As a result, the transferred risk largely determines whether or not the PPP is VfM (Burke & Demirag, 2015; Jin & Zhang, 2011; N. Wang, 2014), and, as a key determinant, may need to be updated as negotiations proceed and economic balance between the entities has to be preserved.

Since there is no unique method how to allocate particular risks between the public and private sector, there is a real challenge to calculate the optimal values of retained and transferred risks as both involve subjective and qualitative judgements (Khadaroo, 2008). Changes of the assumptions regarding the allocation of risks can easily shift the balance between the CP option and the PPP option. This discloses that risk transfer in the PPP is conceptually flawed. Several reasons can be excluded accordingly (Burke & Demirag, 2015; Shaoul, 2005).

First, risk transfer as well as the entire VfM assessment methodology depends upon the possibilities to determine and attach probabilities and values to a range of

[27] An exception is the approach used by Infrastructure Australia (FWHA, 2012). See Section 1.3.2.

[28] See Section 1.2.1

outcomes, which, given the lack of sound prior evidence to base the risk estimates (REs), is inevitably a subjective process (Burke & Demirag, 2015; Daito & Gifford, 2014; Wang, 2014). Although there are increasingly sophisticated systems for the evaluation of risk transfer (Kokkaew & Wipulanusat, 2014), whey can only be as good as there are the basic estimates of probability and costs of risky events. If these are unrealistic, then all calculations of risk transfer become unreliable. While, according to Ball (2011), there is an often practice when risk is assessed and allocated by the project team in the workshop environment by using very amateurish ways. A review of literature regarding risk assessment discloses that the probability-impact (P-I) risk assessment model is prevailing in practice, while the models based on historical or benchmark data are in comparison less used (Jasiukevicius & Vasiliauskaite, 2015a). Despite this practice and, therefore, potential huge subjectivity in the results of risk assessment, real money is paid for these risks.

Second, irrespective of how much risk is transferred to the private sector, it should not be forgotten that the public sector, as earlier explained[29], is a final guarantor and at the end bears all risk related to the provided public infrastructure and services.

Third, risk methodology does not necessarily align risks, outcomes and penalties correctly e.g., if infrastructure or services is unavailable for its direct users, the private subject is typically punished by reduced payments and/or compensation from the PPA, however, the direct users as victims, are usually not compensated for their loss (Evenhuis & Vickerman, 2010; Shaoul, 2005).

Forth, there is no unanimous opinion whether the PPP creates additional risks to the PPA (Yin Wang, 2015), and, if it does, whether their cost has to be included in the PSC. On the one hand, the PPP may cause the costs of the PPA being locked into a long-term inflexible contract (Poulton & Macartney, 2012; Sarmento & Renneboog, 2016; Wang, 2014) or, in case of the failure of PPP contract, create transitional period costs (Fernandes et al., 2015; Jin & Zhang, 2011; Parker & Hartley, 2003; Schepper et al., 2014; Vagliasindi, 2004) that is in favor of cost of these risks to be included in the comparison. On the other hand, the assessment of these risks makes the already highly complex risk analysis even more complicated and, usually due to a lack of data available to systematically evaluate whether the PPP schemes provide effective risk transfer and represent VFM compared to other forms of procurement, subjective (Burke & Demirag, 2015).

Fifth, if the costs of risk premium are included in FDR, it is complicated to allocate the risk between the public and private entities by adjusting different FDR for the PSC and the PPP option, since FDR reflects opportunity cost, while allocation of risk is mostly based on division of tasks (Shaoul, 2005). Finally, risk allocation has to be based not only on the minimization of costs, but it also has to be ensured that risks are transferred in ways that are legally and practically enforceable (Gupta et al., 2013; Tamosiunas & Zilakauskyte, 2010; Andreas; Wibowo & Alfen, 2015). However, since the PPP contracts are usually not in the public domain due to

[29] See the section 1.2.3.

commercial confidentiality, it is difficult to analyze this aspect based on actual contract (Khadaroo, 2008; Shaoul et al., 2012).

In certain cases of PPP, there is an obligation for the private sector to pay certain additional taxes and insurance premiums that do not exist in the reference IP (PSC), because the entities of the public sector can be exempted from certain taxes and undertakes all risks. Moreover, there is a fact that some of the costs of the PPP represents tax revenue, which returns to the government. This determines the distortion that often exists between the same tasks of the private sector and those of the public sector and aggravate their comparison. The issue usually concerns taxes related to land, property, payroll, local government and capital transaction. Therefore, there is a need to set out the necessary policies or legal measures to ensure *CN*, that would enable a comparison of both options on an equal and objective basis. As a solution, this requires an increase of cost in the PSC to represent a true "apples-to-apples" comparison. However, regarding CN, there is no unanimous opinion on whether to distinguish among the various levels of government to whom taxes are paid, since the taxes paid to the national government could be treated differently from the state and local taxes (EPEC, 2015b; Grimsey & Lewis, 2005; Tsamboulas et al., 2013; Xueqing Zhang & Chen, 2013). For example, taxes, certain indirectly counted in payments from the local government to the private subjects, paid to the national government may not return as revenues to local government. Therefore, the realization of CN from the perspective of local government can differ from those of national level, which discloses the potential principal-agent problem between the different levels of government discussed earlier[30]. On the other hand, from the perspectives of the consolidated public sector accounting and benefits for society, the distinction between different levels of government vanish and competitive advantages of the public sector against the private one in respect of taxes is evident. As a result, regarding the calculation of CN, there is no unanimous point of view on whether to draw such a distinction between different levels of government.

Usually, VfM assessment is focused on efficiency, i.e. the risk-adjusted financial costs of providing what is assumed to be an equivalent output. However, since not all the benefits of a particular option can be conveyed through financial costs, *NFBs* may be not less important for rational comparing of the options (Mota & Moreira, 2015). The features and advantages of PPP described in Section 1.2 allow arguing that a PPP is specifically intended to deliver greater NFBs than CPs. Therefore, it is theoretically believed that NFBs under the PPP can be greater than under CP. However, each case requires individual assessment.

Considering the incremental basis VfM of PPP NFBs can be in principle captured through three key aspects (EPEC, 2011): accelerated delivery (Bin & Quan, 2012; Liu et al., 2015; Parker & Hartley, 2003; Wang, 2002), enhanced delivery (Ng et al., 2012; Zawawi et al., 2014) and wider social impact (Abednego & Ogunlana, 2006; Hellowell, 2013; Hwang et al., 2013; Silvestre, 2012). Regarding the first aspect, PPPs can accelerate the delivery of an infrastructure and

[30] See the section 1.1.1.

related services in two main ways: 1) through various financial incentive mechanism incorporated into the terms of the contract, it encourages the private entities to deliver infrastructure on time, which decreases the potential social cost related to infrastructure and services being inaccessible to society in case of delay, and; 2) due to the involvement of private capital, the PPP can provide additional financing for the public sector that can help to accelerate investment programs and make infrastructure and services accessible earlier than under CP, which is a social-economic benefit with all associated externalities for society. Considering the second aspect, the enhanced delivery may be achieved due to at least four features of PPP: 1) application of life-cycle approach resulting in better asset conditions and higher residual values at the end of PPP contract; 2) development of contractual commitments in such a way that both better designed and higher quality of infrastructure and service delivery is achieved, and; 3) potential to achieve the benefits associated with increased external scrutiny by lenders and investors, better management of infrastructure and service delivery, and more possibilities for the public sector to concentrate on its core tasks, and; 4) higher amount of infrastructure and services being available for the same annual budget due to the payment profile under the PPP. Regarding the third aspect, NFBs of PPPs are related to the positive externalities of using the PPP, i.e. the benefits to parties which are not the direct users of an infrastructure or services delivered under the IP. These benefits can be divided into two categories: 1) Wider public sector benefits, which can be very diverse and are particularly difficult to quantify or value, e.g. benefits of potential-to-replicate design, management and technology innovations in the future IPs, better understanding of specific risks in the IPs, better allocation of public resources because of application of whole life-cycle approach, lower costs of CPs' bids because of higher competition from the PPPs, etc.; 2) Wider macro-economic benefits, which are the same for both PPPs and conventional IPs; however, if, due to e.g. financial constraints, PPP is the only real option to implement an IP , they can be included based on time preference as far as they do not duplicate NFB related to the first aspect in the VfM assessment as PPP ensures their earlier delivery, e.g. investments encourage employment in the private sector, development of infrastructure increases economic competitiveness, etc.

The majority of the above-mentioned NFBs are based on the assumption that the private sector in general has advantage in respect of technology and efficiency against the public sector as well as, the PPPs allow getting benefits earlier than in the case of CP due to budget constraints that, as discussed in Section 1.2.3, both are not necessarily true in individual cases. Moreover, the budget constraints for particular investments under CP are also conditional, since they depend on the priorities of the public sector to allocate the resources for particular fields of investment. Financing can be found for a CP, if it is prioritized accordingly. Thus, since the application of NFB is quite subjective, every IP requires case-by-case assessment.

Regarding the comparison of costs associated with both procurement methods, beside investment, operation and financing costs which are the base for evaluation, there are also *transaction costs,* which, according to Parker & Hartley (2003),

Schepper et al. (2014), have not always received much attention in evaluating procurement methods, although they can also make a difference between the options. In the context of PPP, transaction costs refer to costs of establishing and maintaining the PPP or establishing and monitoring several contracts under CP that are usually accompanied by legal, technical and financial costs incurred by both the public and private sectors in the procurement and operational phases of the IP. Since the PPP contracts are traditionally more complex and it is time consuming to arrange them as well as to organize tendering, evaluating, negotiating and selecting bids, it is argued by many scientists (Fernandes et al., 2015; Gudelis & Rozenbergaitė, 2004; Mota & Moreira, 2015; Mu et al., 2011; Sarmento & Renneboog, 2016) that transaction costs of PPPs, as discussed in Section 1.2.4, are likely to be higher than in the case of CP. This implies that for objective and transparent VfM assessment these additional costs occurring in the PPP option have to be added to this option or deducted from the PSC. However, since there is no reliable systematic study on the comparison of transactional costs between the PPPs and CP options that was also stated by Schepper et al. (2014), it cannot be strictly stated that transactional costs of PPP are significantly different from CP. Moreover, the development of PPP market allows accumulating the best practice of such IPs' procurement, that, in turn, enable the public sector to develop the standard PPP procurement documents and frameworks which have a potential to decrease transactional cost of other PPPs (Janssen et al., 2016). Therefore, since there are no summarized results on transactional cost in different procurement options[31], whether transactional costs have to be included in the comparison, the decisions require case-by-case assessment and are likely to be subjective.

Beside the above-discussed aspects related to what has to be included in the PSC for rational VfM assessment there is also a need to ensure that the PPP option is financially affordable given the future impact on the PPA's liquidity and even state solvency (Sarmento & Renneboog, 2016). If future payments under the PPP threaten the sustainability of public finances or/and the price for direct users is too high, even if the PPP may have a lower NPC, it becomes unaffordable, resulting in inaccessibility of improved infrastructure and services to the society. Therefore, affordability is crucial. As a result, the PPP needs to be structured as well as negotiated in such a way that it would remain within the government's and users' affordable range (Yinglin Wang & Liu, 2015). However, according to Gupta et al. (2013), Moro Visconti (2014), Shaoul (2005), Yinglin Wang & Liu (2015), despite the importance, relatively little attention is given to affordability, determining the potential risk of affordability gap and the negative consequences for public finance.

While affordability as a concept is no less problematic than VfM (Rossi & Civitillo, 2014; Felix Villalba-Romero, Liyanage, & Roumboutsos, 2014). It is very flexible and since there is no its prescribed methodology or criteria, it is identified only by affordability 'ceiling', beyond which the PPA should not go. However,

[31] Thomassen, Vassbø, Solheim-Kile, & Lohne (2016) have provided a case study of a new primary school in Norway, which showed that ex-ante transaction costs are equal around 7–8% of total project cost.

typically, there are also no precise procedures for justifying the "ceiling" in the public sector. Since it is presumed that private participation increases cost-efficiency and allows spreading costs over the life of the PPP contract[32], it is logical to associate affordability with identifying the services to be provided, compare their costs against the current costs and overall budget assigned to these services, and identify what, if anything, is displaced by the new arrangements. Here, if the PPA provides UPs for private subjects, for rational (apple-to-apple) comparison, it is important to distinguish separate elements of payment according to its individual structure. For example, the availability fee for infrastructure may be compared, at least conceptually, to the capital costs and charges (interest and dividends on the public capital), and the maintenance costs currently incurred by the public entity which provides services. While the facility management fee for the operation of infrastructure may be compared to costs that are incurred by the same public entity or its sub-contractors via outsourcing contracts. However, as mentioned earlier, the budget available for payments also depends on the priorities of the PPAs, and can be higher or lower in comparison with the current limit. Therefore, without knowing the maximum amount of budget available for financing commitments under the PPP, it is impossible to directly assess whether the payments from the public sector is affordable. Since there is no systemic study on how affordability is assessed in practice, there is no solution outlined in this dissertation.

Finally, regarding the VfM assessment in the context of PPP, not all benefits of a particular option can be captured in monetary terms (EPEC, 2011; Khadaroo, 2008; Mota & Moreira, 2015). For a complex assessment, there is also a need to assess *non-valued effect (NVE)s.* Since research is mostly focused on qualitative analysis and mostly scored only qualitatively (namely 'yes' or 'no'), the options under the quantitative VfM assessment are not conceptually included in the comparison, they are important as additional criteria allowing deeper and wider assessment to be carried out and ensuring the rational decisions to be made throughout the process of the VfM assessment (EPEC, 2015b; FWHA, 2012). For example, it might be important to assess whether the IP in respect of investment amount, integration with existing assets or networks, consistency over time, possibilities to measure performance, asset lifetime, maintenance and refurbishment requirements, factors influencing or limiting transferability of IP's maintenance and operation tasks, innovation requirements, scope for the private subject to generate additional ancillary revenue, etc. has potential for deeper quantitative analysis for expediency of its implementation under the PPP, or whether there is any interest in the market for the PPP option, resulting in a qualitative competition of bidders and, herewith, delivering VfM. These criteria for an IP can involve many aspects, e.g. safety, capacity, reliability, service quality, legal feasibility, etc. (Burke & Demirag, 2015; Gupta et al., 2013; Hickford et al., 2015; Janssen et al., 2016; Khan & Mushtaq, 2009; Martins et al., 2011; Ng et al., 2012; Sambrani, 2014; Sarmento & Renneboog, 2016; Felix; Villalba-Romero & Liyanage, 2016; Xu et al., 2012). For the VfM assessment, the checklists of these criteria are usually used.

[32] See Section 1.2.3., where the advantage of PPP is explained.

The existing variety of criteria differing in their emphasis, point of nature in the IP development cycle discloses the existence of a wide range of approaches applied to assess non-valued effects and combine them with the overall VfM assessment. According to EPEC (2015b)[33], these approaches can be divided into six main categories. The main differences between them are revealed through the stage of IP development when the VfM assessment is performed, which determines what non-valued effects at a particular point are relevant and can be evaluated as well as how they can be combined with the results of quantitative VfM assessment. The main features of different approaches are presented below.

Under the approach such as in Australia (Australian Government, 2008), the assessment of the non-valued affects is performed only in the *early phases of the procurement*, therefore, since there is no quantitative analysis yet, the qualitative factors alone are used to perform the analysis and are not weighted against monetary outcomes in this stage. Instead of this, the positive results of qualitative assessment give reasonable arguments for the quantitative VfM assessment needed to be carried out in the next stage.

In Germany, where a *basic qualitative approach is a supplement to a valuation assessment*, it is more focused on non-valued effects only if the results of the quantitative analysis are too close to unambiguously assess the best one. Herewith, there is no standard list of criteria and the assessment is structured according to particular requirements every time. A similar approach is used in France; however, to proceed, there is a legal requirement to demonstrate the PPP as the most efficient option to deliver public infrastructure and services. While the comparative analysis is focused on the qualitative impact of each procurement option in terms of performance and sustainable development and disclosure of additional benefits and possible disadvantages possible of the PPP option. The results of the qualitative assessment are usually weighted more heavily than the results of the quantitative assessment when the differences between the quantitative results for the conventional option and the PPP option are small as well as when there is a high level of uncertainty around the input variables used in the quantitative assessment, while the outputs are highly sensitive to them.

The most *extensive qualitative approach combined with the quantitative assessment* is applied in the UK, where the assessment of non-valued effects, alongside the quantitative assessment, is performed both in the early and later stages of the IP's development with the emphasis tailored to the relevant stage of the IP, accordingly. For example, the interest from the market and the quality of competition, the abilities of PPA to efficiently manage the procurement process is more emphasized at the initial stage of procurement. While the criteria related to the assessment of the PPA's satisfaction regarding its chosen funding and contract structure, the benefits of PPP outweighed the expected higher cost of capital and

[33] No scientific studies have been found in which different approaches of non-valued effects in VfM assessment are analyzed. The study presented by the European PPP Expertize Center (EPEC, 2015b) is the first, in which the different approaches concerning VfM assessment, although rather fragmentary, are analyzed.

achievability of procurement program are usually assessed in the later stages. They can be separated into three the main parts: 1) viability, which addresses the question of whether the IP is suitable for long-term contracting; 2) desirability, which overlaps with the financial analysis as it addresses the question of whether the expected benefits outweigh the additional cost factors, and; 3) achievability, which includes the analysis of the market interest as well as timing issues, the capacity and capability of the PPA to manage different delivery options. As in Germany and France, the positive results of the assessment of non-valued effects must be demonstrated for the IP to be considered for implementation under the PPP procurement. The viability and achievability of the PPP option is a precursor to determine whether there are real PPP options that can be compared for VfM. Therefore, their assessment can be separated from the VfM analysis itself.

In the UK, the approach to assess non-valued effects is used not only at the procurement stage, but also when bids are actually received from the market to assess whether the procurement still involves sufficient competition to achieve a competitive price. This is relevant since there is a risk that a theoretically derived PPP option may look cheaper, it may still not represent the best VfM, since the quality of the competition at the initial procurement stage is unknown. It may be revealed that, in fact, due to an incomplete analysis and/or absence of competition, e. g. where because of a poorly run competitive process, only one competitive bid from the market was received, the CP option was overpriced, resulting in an overvalued VfM. Therefore, at any point during the procurement process, it should be carefully considered whether the PPP option, including the non-valued effects, still provides the best VfM and it is worth to proceed. Unfortunately, the qualitative assessment at the later stages of IP's development process is rarely used among the countries.

The *approach as a supplement to quantitative valuation*, as applied in Belgium, distinguishes the quantification of results of qualitative assessment, where the outcome of analysis consisted of three components, such as social, operational and financial values which are got by asking whether the choice for a PPP procurement option leads to a different outcome for that component, and are scored, summed up and translated into a generalizing index. Weights of each components' outcome included in the generalizing index are determined considering an appropriate formula, where the factors of financial and social indexes are prevailing 0.5 and 0.4 respectively. While, the remaining factor applied to the operational index is 0.1. The general index represents how much the outcome of PPP generally differs from the conventional option in terms of non-valued effects. However, the individual outcomes for each of the three elements are also often presented.

The last approach distinguishes the *ex-post analysis of VfM*, which is not always conducted through a predetermined structure. Typically, it involves the qualitative assessment and focuses on the processes that were followed when conducting the preparation of the procurement of the IP and related assessment tasks and risk allocation.

Despite different approaches, in most countries, the qualitative assessment is considered as a vital element in the comparative complex analysis of both delivery

options. However, not all methodologies include non-valued effects specifically as part of the VfM assessment. This does not mean their complete exclusion from the decision-making for PPP's implementation. In these cases, the non-valued effects are usually assessed in a separate analysis or through other mechanisms of decision-making. The difference of the main approaches regarding the assessment of non-valued effects are more deeply analyzed in the following section of this dissertation.

To conclude this section on the conception of VfM assessment, VfM assessment is highly complex, including many elements of both quantitative and qualitative assessment, which are widely discussed and can be used differently, depending on the approaches applied. This discloses VfM assessment for PPP as a very flexible concept which can be adopted depending on the requirements. However, this also shows that the results of VfM assessment are rather subjective, since they highly depend on the assumptions used and the preconceptions applied. Therefore, for greater objectivity and reliability of the results, it is important to ensure consistency between the separate aspects of VfM assessment resulting in a complex systemic model provided, which is pursued to be the results of this dissertation. The following section provides a more detailed analysis of some prevailing practices regarding separate aspects of VfM assessment, possible to adapt for this purpose.

1.3.2. Comparative analysis of VfM assessment practices

Since the concept of VfM assessment and its main elements were analyzed previously as well as the major disputes concerning the methodological assumptions used in this assessment, this section of the dissertation is intended for a deeper analysis of the prevailing methodologies of VfM assessment among different countries. More specifically, it is focused on comparative quantitative analysis of VfM assessment at the preparation stage. Since the scientific literature concerning VfM assessment, despite constant development of VfM assessment practices, still remains very fragmentary, a comparative analysis is mostly based on information gathered from various guides on VfM assessment across the countries (Burger & Hawkesworth, 2011; Commonwealth of Australia, 2008; EPEC, 2015b; FWHA, 2012; HM Treasury, 2006; Infrastructure Ontario, 2015). The analysis focuses on methodologies of the countries where the PPP market is comparatively the most developed, such as the UK, France, Germany, the Netherlands and Australia.

The analysis disclosed that the VfM assessment is not strictly regulated in any of the above-mentioned countries and, concerning the quantitative VfM assessment, the guides are more likely to present various approaches concerning the main elements of the assessment instead, most of which have also been discussed in the previous sections of this dissertation, than they are likely provide a clear description of how to practically perform the assessment. On the one hand, this suggests that every case of assessment of PPP's possibilities to optimize investments in the public infrastructure and services is fairly individual and, therefore, requiring particular adjustment every time. On the other hand, since the initial analyzed resources are primarily guidelines for practitioners, they, in their nature, usually do not go into deep methodological analyses and systemization of various approaches where the

most rational one could be discussed and found. Despite this, some important differences among the methodologies can be noticed. They reveal through three main aspects: cost identification, risk reflection and present value calculation (Appendix 4).

Regarding cost identification, typically, cost and revenue estimations for the PPP option and the CP option are not identical, since there is a notion that the private partner is likely to generate life-cycle cost optimization. In France and Germany, it is presumed that, in comparison with the CP option, the raw costs of PPP will be lower, thus they are adjusted by the predetermined efficiency factor. Similar prejudice concerning efficiency is met in the UK; however, it is asserted in a particular adjustment of costs to assess the risks. While in other countries, such as the Netherlands, Belgium and Canada, the assumptions about the efficiency of the private sector are applied only if there are reasoned arguments, i.e. from previous similar examples, to do so and by a particular percent considering various potential aspects.

All analyzed methodologies assume that risk adjustments for both the CP and PPP options are identical, except for those risks for which specific differences can be identified. Although a way to reflect risk through the adjustment of FDR is also presented, the alternative way of risk adjustments through the CFs is prevailing. For risk assessment, various methods from a simple P-I matrix to sophisticated Monte Carlo simulations are used. In the UK, as mentioned above, the CFs are adjusted based on the expected optimism bias and expected risk-adjusted values. This increases cash outflow in the CP option as well as the expected availability fee required by the private partner that makes the PPP option relatively cheaper.

The most significant differences among methodologies appear in determining and using the FDR for VfM assessment. Regarding this aspect, three different approaches can be distinguished.

Under the first approach, such as the one applied in Canada, Germany and France, the FDR equals the actual public sector's cost of financing, where no additional project-specific risk premium is added to the FDR. However, there are some differences among these countries with regards to how the FDR is determined. In France, FDR equals the standard borrowing rate of the public sector's entity, since the assessment is focused on the financial assessment from the microeconomic perspective, i.e. from the PPA financing level. Canada uses the approximate average loan life method. While in Germany, the FDR equals the cost of loan, the maturity of which is equivalent to PPP project's period. In all these modifications, the FDR varies with market interest rate. Therefore, if the market interest rate goes up, both the CP option and the PPP option becomes affected[34].

Under the second approach, which is used in the UK, the FDR is fixed at a certain period of time and equals to STPR where, as in the previous case, no project-

[34] If the unitary payments from the public sector are paid for the private partner, the changes in market interest rates do not have an equal impact on the NPC of the options. The effects of higher and lower DR on the NPV of the option are disclosed in Section 1.3.1 of this dissertation.

specific premium is included. Since the FDR is fixed, it does not vary with changing market interest rates or sector-specific risk. This means that, if the market interest rate or sectorial risk increases, the FDR remains unchanged.

The third approach is used in such countries as the Netherlands and Belgium, where the FDR equals to market-based government borrowing rate including full project-risk premium. This means that all costs included in the private cost of capital represent cost to the economy that is also borne by the public sector. Since under this approach the FDR for both options is equal, the changes in market interest rates lead to an adjustment in the FDR but, in general, there is no difference in the outcome, if the effect of time preference is not considered.

Irrespective of which of the approaches is used to determine the appropriate FDR, for VfM assessment usually the same FDR is applied to the CFs of both procurement options. Therefore, since the actual cost for PPP option is equal to the weighted cost of private capital, the differences between the cost of PPP option and the public sector's FDR have to be reflected through the adjustments of CFs of the PPP option ensuring that there is no double counting or omission of the related risks. The exception is the approach used in Australia and Belarus where different FDRs are applied to PSC and PPP options, utilizing the CAPM only for the PPP option to account for systematic risk within the IP's CFs. According to this approach, to discount "risky" CFs beside a risk-free FDR a risk premium is added, while for "non-risky" CFs risk-free FDR is used. As a result, the FDR of the PPP option is compared with the PSC. This practice is based on the theory that since the public sector transfers its systemic risk to the private sector, the latter should be compensated through a higher rate of return. However, this approach can be also criticized for making artificial advantages for PPPs.

The analysis of quantitative VfM assessment methodologies allows concluding that the main methodological reasons for differences in the results between the CP and PPP options are determined by differences between the public entity's FDR and the cost of private capital and the preconceived assumptions about higher efficiency of the private subject expressed in lower costs of the PPP option or higher costs of the PSC. There is also the effect of time preference, which also makes the cost of the PPP option lower. However, this, in general, has the same impact on CFs despite which of the approaches is adapted. Other differences in the results between the procurement options are mostly determined by the individual assumptions used in every IP.

Literature is very limited in the analyses of how different VfM methodologies have been developed and why particular approaches have been chosen to be applied in different countries. The fragmentary articles of Ball (2011), Grimsey & Lewis (2005), Harada & Ogunlan (2015), Khadaroo (2008), and Tsamboulas et al. (2013) allow concluding that the development of VfM assessment methodologies is determined by individual political, economic, financial factors as well as various incentives and lessons learnt in every country. There are also countries where VfM assessment is not officially defined and applied only fragmentarily. Lithuania is also among those countries where full standardized VfM assessment methodology is still

not developed as well as VfM assessment is not applied as an official procedure in the process of PPP procurement[35].

Despite different approaches applied for VfM assessment it is relevant to analyze factors that increase VfM for the public sector to get the most benefits from the private sector's participation in the provision of public infrastructure and services, especially where the experience of PPP procurement is still small, which is done in the following section of this dissertation.

1.3.3. Factors increasing VfM

The success of an IP is typically associated with the goals to complete it within the budget, time schedule and quality standards (Medda, 2007; Ng et al., 2012). The PPP IPs are no exception, and they also strive to achieve better VfM in comparison with the CP. Since the results of VfM depend on an appropriately constructed PPP, whether it will be achieved successfully or not relates primarily to the purpose of formulating and building a viable, stable, and effective PPP. This determines the requirement to analyze CSFs as well as "barriers" for PPP's implementation. Gordon et al. (2013) define CSF as "the limited number of areas, the result of which, if they are satisfactory, will ensure successful competitive performance for the organization. They are the key few areas where 'things must go right' for the business to flourish". Logically, barriers are considered to be anything that interferes with the CSFs (Khan & Mushtaq, 2009).

A number of CSFs or drivers to the success of PPP have been explored by various researchers (Bao et al., 2014; Desgrées du Lou, 2012; Gordon et al., 2013; Kavaliauskaitė & Jucevičius, 2009; Moro Visconti, 2014). Among them Andreas; Wibowo & Alfen (2015) and Gupta et al., (2013) have distinguished 30 CSFs, while Ng et al. (2012) have identified as many as 36 CSFs. Since they cover many aspects of PPP IPs' implementation, there is a requirement for their systemization. Yin Wang (2015) conducted an extensive review into the CSFs and classified them considering three perspectives from which the PPP development can be analyzed: external environment, internal IP's characteristics and partnership-related factors (Table 1.3).

Table 1.3. CSFs for PPP development (adopted from Yinglin Wang & Liu (2015))

External environment	Internal IP's characteristics	Partnership-related factors
• Infrastructure demand • Financial situation • Political ideology • Relevant legislation	• Resource availability • Financial viability • IP type and complexity • IP requirements • IP design • Contract documents • Project management	• PPP-related PPA capacity • Private partner selection • Role division • Risk allocation

Regarding the external environment, the scientist included the following factors as important for the development of an effective PPP: 1) Overall infrastructure

[35] It is expected that the results of this dissertation will be a basis for the development of VfM assessment methodology in Lithuania.

demand, which matters as large aggregate demand bringing good chances of investment returns and, therefore, attracting private investments; 2) Financial situation, which asserts in a way that PPP allow the government to meet the growing demand of public infrastructure in the context of fiscal constraints and deliver improved public services at lower costs; 3) Political ideology, which has a strong impact on the development of favorable environment for PPP framework implementation or, due to concerns about the loss of public can restrict the participation of the private sector in the public one; 4) Relevant legislation, which shapes the legal and regulatory environment within the jurisdiction for PPP formation, operation, and sustainability that, if it is strong and effective, allows decreasing the uncertainties of legal regulation and increase the chances of success for PPPs.

From the perspective of internal IP characteristics, it is widely considered that the success of a PPP strongly depends on factors such as the availability of financial and other resources, IP's financial viability, IP's technical complexity, IP's requirements regarding government permission, quality, environment protection, safety and others, completeness of project design, completeness of contract documents, and effectiveness of project management functions, such as planning, coordination, monitoring, and controlling. All these factors have impact on PPP's efficiency and effectiveness.

From the perspective of relation between the public and private sectors, four important factors can be distinguished: 1) PPP-related government capacity, which refers to its expertise, knowledge, decision-making mechanisms, administrative systems and credibility to manage the process of procuring and supervising PPPs; 2) Selection of the right private partner, which is crucial for building a successful PPP and getting the advantages from the participation of the private sector, analyzed in Section 1.2.4.; 3) Division of roles and responsibilities among the public and private parties, which is crucial in respect of reducing uncertainty and transaction costs, and for which the PPA is mostly responsible; 4) Risk analysis and allocation which refers to proper assessment of risks and, as discussed in Section 1.1.1.2., allocation of risks to the parties best able to manage them at the least costs, which allows reducing the costs of IP and improving the potential for success of PPP.

Literature also provides other classifications of CSFs, which differ depending on the aspects of PPP's implementation to be distinguished. Ng et al. (2012) have provided several classifications. Considering the key aspects of improving PPP's procurement, they have provided a package which contains five main CSFs: 1) favorable investment environment; 2) economic viability; 3) reliable concessionaire consortium with strong technical abilities; 4) sound financial package, and; 5) appropriate risk allocation via reliable contractual arrangements. Considering the viability of PPP, the scientists present a classification which divides CSFs into four main groups: 1) financial and commercial factors; 2) political and legal factors; 3) technical factors, and; 4) social factors. They also provide a classification based on the characteristics of different aspects of risk involved in the PPP IPs, under which CSFs are divided into six categories: 1) technical; 2) financial and economic; 3) social; 4) environmental; 5) political, and; 6) legal. Andreas; Wibowo & Alfen

(2015) have classified the government-led CSFs in PPP infrastructure development into six groups: 1) legal and regulatory provisions; 2) policy framework; 3) public sector capacity; 4) IP preparation and planning; 5) IP procurement, and; 6) contractual arrangement. Gupta et al. (2013) have distinguished the CSFs for successful implementation of BOT IPs, which were divided into six groups of aspects: 1) prevailing environment; 2) financial viability; 3) concessionaire consortium; 4) financial package; 5) risk allocation, and; 6) technical solution. A comparative analysis of these classifications has disclosed that for a successful PPP, which is considered the initial assumption for the achievement of VfM, many different areas are important which are related to various technical, financial and economic, social, political and legal, and management aspects. This correlates with the approach that the VfM assessment has to include both quantitative and qualitative assessments.

Since there are many factors determining the success of PPP, it is important for decision-makers to identify factors, the impact of which is considered as the most relevant for VfM achievement. Accordingly, the above-mentioned scientists (S. T. Ng et al., 2012) have presented research performed in Hong Kong, where the most relevant CSFs for the success of PPPs amongst three types of stakeholders, such as the public sector, the private sector and the community were ranked. Its results, provided in Appendix 5, disclosed that, in general, all factors have a mean rating higher than midpoint 4 in the 7-point Likert scale, indicating the importance of the identified factors to ensure the feasibility of PPP. The difference among these factors regarding this aspect is not considerable, since 28 of 36 factors have been rated between the scales of 5 and 6, the "acceptable level of toll/tariff" of which (mean = 5,78) as well as "available experience, strong and reliable private consortium" and "long-term demand for the products/service" (means of both = 5,72), "government's strategic and long-term objectives" and "stable and reliable delivery of services (means of both = 5,71) were among the most important factors. Although the differences among the priorities of different stakeholders are not significant, the tendencies to distinguish factors related more to cost efficiency from the public sector, match the government's strategic and long-term objectives, possibilities of an effective control mechanism over the private consortium are observed. The private sector emphasizes the factors related to the financial interest of IP to the private sector, bankability of IP, and long-term demand. The differences from the perspective of the community assert by emphasizing the factors of acceptability of toll/tariff level, understanding and supportive from the community, stable and reliable delivery of services. The survey of Andreas; Wibowo & Alfen (2015) performed in Indonesia has disclosed that among the top five most important factors were a sound legal basis, an irrevocable contract, sensible, and manageable risk-sharing arrangements, clearly defined coordination mechanisms, and strong political support. The findings of Gupta et al. (2013) from India have shown that a concession agreement, short-construction period, selection procedure of concessionaire, sufficient long-term demand and sufficient net cash inflow emerged as the top five factors critical for the success of the BOT IPs. Specifically for the VfM achievement, Moro Visconti (2014) distinguished key drives, such as financial

innovation, institutional/legal stability, performance monitoring, proper allocation and management of risk, proper balance of conflicting public versus private interests, etc. Harada & Ogunlan (2015) have provided positive evidence from Japan of the relation between the number of private subjects providing the proposals and the bidding results. The higher number of competitive private subjects, the lower procurement price drop that is also argued by Zitron (2006), Link & Scott (2001). Regarding this factor Hanák & Muchová, (2015) also state that the number of bids in the tender plays a significant role in the context of the overall efficiency of the IP. This suggests that increasing the number of participant firms could contribute to raising the VfM.

The factors decreasing VfM come from the general barriers to PPP IPs' implementation. Janssen et al. (2016) identified 37 barriers to PPPs in the IPs of road development, four of which are: 1) difficulties for local governments to adopt new working methods related to the application of PPPs; 2) belief of local government employees that the application of PPPs might effectively exclude local contractors from the involvement in projects; 3) lack of government experience with the whole PPP approach, and; 4) the PPP contracts as being too complicated, consistently stand out. Babatunde et al. (2015) identified 58 barriers as seriously influencing PPP IPs in Nigeria. Their findings disclosed that potential conflicts of interests among the stakeholders, politicization of the concessions or political interference in the procurement process, uncertainty of political environment or political instability, lack of transparency and accountability, poor financial projections and access to funds, inability of local institutions to provide long-term financing or equity financing, perceptions of a country or nation as high risk economy by foreign investors, difficulties in securing credit facility from banks, and poor evaluation, monitoring, and due diligence by the public sector were the nine top-ranked barriers for the PPP IPs' implementation. These and many other barriers that interfere with the above-mentioned CSFs which can be found in both of these researches, have to be considered in decision-making and planning towards PPP IPs' implementation.

All the above-mentioned factors allow summarizing that VfM is a result which depends on many technical, economic, financial, social, political and managerial factors. Since they have to be evaluated and compromised by various stakeholders, the assessment of PPP's possibilities to optimize investments in public infrastructure and services is a demanding and challenging task.

1.4. Summary of theoretical research on the assessment of PPP's possibilities to optimize investment in public infrastructure

Regarding the purpose of the research, this part of the dissertation analyzes the theoretical aspects of the assessment of PPP's possibilities to optimize investments in public infrastructure. It consists of three major sections which analyze and summarize the theoretical premises of collaboration between the public and private sectors, PPP as a possibility to optimize these investments in public infrastructure and, finally, the theoretical aspects of assessing PPP's possibilities to do so.

The analysis of theoretical premises for collaboration between the public and private sectors allowed distinguishing the main reasons determining the appropriate services and infrastructure being unable to be delivered or trust to be delivered entirely by the private sector and, therefore, under the name of "public", remaining with the responsibility of the public sector, which makes the appropriate interventions. Since this requires constant investments to ensure a positive net impact on economic development and social welfare, a task and responsibility of the GAs to maximize these values to society available to get from the public resources was emphasized. Considering the identified financial and budgetary constraints in the public sector, the rationality for the GAs to create opportunities and conditions for the private sector and to participate in the delivery of public goods was stated, if it can suggest a greater value and/or efficiencies additional to those obtainable from purely the public sector. It was found out that the more benefits can be suggested from the private sector, the more tasks can be transferred to them at a valuable price, the more, instead of being a provider, the public sector can remain the guarantor and retain only the overall operational responsibility, while the provision can be committed to the private sector. Growing private participation in public infrastructure and services delivery discloses an appropriately changing role of GAs in the provision of public facilities and services from the provider to a strategic investor which, by focusing more on strategic planning and regulation functions, also gets more possibilities through the investments for maximizing social-economic benefits.

An analysis of historic development of collaboration between the public and private sectors revealed this process as being especially pushed by various neoliberal ideologies. The developed concept of NPM encouraged GAs to adopt business and market principles, management techniques and rationalities from the private sector as well as rely more on private provision.

However, it was also revealed that private participation in the provision of public services and infrastructure determines the challenge for the GAs to overcome specific issues explained by the agency and related theories. Accordingly, the importance of GAs' role in solving it and decreasing possible inefficiencies related to the cooperation with the private sector through a well-designed tender procedure was emphasized as well as the formulation of a contract that contains adequate incentives, strict monitoring and enforcement of the provisions in the contract. However, the analysis allows stating that the proper fulfillment of these conditions remains a relevant issue since there are many problematic elements of the contract needed to be properly determined and relevant factors to be considered; this requires a well-established legal/regulatory framework and a developed market which could effectively regulate the field of public and private sectors' contractual relationships, enable and facilitate the contracting of long-term partnerships with the private entities. Moreover, this includes individual risk allocation between the public and private parties, the optimization of which, as it was disclosed, is challenging and demanding, once again determining the responsibility of the GAs to develop models, tools and techniques as well as to create a favorable environment, enabling to achieve proper contractual arrangements, emphasized by the balance of interests

between the parties and the best achievable VfM for the public sector. Accordingly, the analysis allowed summarizing that the more GAs put efforts in creating a favorable environment for alternative ways of implementing investment, the higher potential there is to optimize investments in public infrastructure by involving private entities.

The analysis of literature concerning the optimization of investments in public infrastructure allows summarizing that this process is mostly analyzed through the social-economic and financial aspects. Regarding the economic aspects, it is mainly discussed in the context of economic performance, more specifically, its productivity and efficiency. Here, the findings, especially in the later studies, generally support the notion of investments in public infrastructure being productive and contributing to the economic development. They also allow arguing that a well-developed and well-maintained infrastructure, including properly implemented investments, plays a vital role in supporting a high standard of living, encouraging the private investments and facilitating commerce and trade, enhancing attractiveness and competitiveness of economy, thereby extending nation's global wealth. Regarding the financial aspects, the optimization of investments in public infrastructure focuses on cost-efficiency, which includes three main dimensions: determination of optimal capital structure, minimization of life-cycle costs, and optimal sharing/allocation of risks between the public and private parties. Literature reveals them being critically important for the VfM achievement but typically complicated both in theory and practice, since only fragmentary solutions for associated issues are provided.

The analysis of interests of the public and private entities regarding public investments allowed distinguishing a number of factors stimulating both parties to collaborate in a long-term partnership. Since the entities of the public and private sectors have different interests within the public IP, the collaboration between the public and private sectors is feasible if the compromise between all parties' requirements can be found.

Since it is important to find the optimal parity between all parties' interests, the first major section was concluded by defining the conception of evaluation of the private sector's possibilities to optimize investments in public infrastructure. When it comes to the role of GAs, the premises and motivators of collaboration between the public and private sectors, optimization is considered as a comparative assessment of all available options of implementing investments to find the optimal one to proceed, i.e. the affordable and viable option providing the highest ratio of benefits and costs (VfM) for the public sector.

The second major section committed to the analysis of PPP as a possibility to optimize these investments in public infrastructure allows stating that the concept of PPP is not consensual. Due to the existence of multiple cooperation forms of the public and private sectors, the scope of PPP conception is still subject to considerable debate. Moreover, the approaches to PPP also vary in every country depending on the settled relations between the public and private sectors and developed legal framework, determining the economic sectors, activities, forms and schemes available for their cooperation, as well as other aspects, determining the

existence of dozens of PPP's definitions across the normative and scientific literature. Nevertheless, their systemic analysis based on the most often identified aspects of PPP in them allowed forming the definition of the PPP. Considering the complexity of the definition, the main characteristics of PPPs have also been distinguished.

A retrospective analysis of development of PPP as alternative way of implementing IP and providing services discloses that it started to be more widely adopted only several decades ago; however, during this period, it significantly increased both in the volume of investments and the number of IPs across the globe. The main drive to attract private capital into the provision of public infrastructure and services in the UK gradually determined the rise of various cooperation forms between the public and private sectors in many other countries. The PPP has become an acknowledged way of investment implementation widely applied in the global public construction and service market. The variety of developed forms, considering their features as well as different amounts of transferred risks, allows the PPAs to choose the right one, depending on the requirements. This allows arguing that the PPP can be flexibly applied in various cases from providing secondary services to designing, building, maintaining and operating infrastructure in many economic sectors. However, since the selection of the most appropriate form and scheme should be the result of VfM assessment, this is still a complicated task and requires facilitated solutions, which the scientific literature is still very limited to provide.

An analysis of the advantages of PPPs allows stating that they are mainly the same factors encouraging GAs to involve the private sector in the provision of public infrastructure and services. Among them, private financing releasing the public sector from commitment to fund all initial capital investments and allowing to spread them over the life of PPP contract instead as well as requiring to be repaid only when the investment stage is finished is substantial argument in favor of PPP as making investments in infrastructure for the public sector more financially affordable and allowing to accelerate them. Other identified potential advantages depend on the existing competition in the market, the quality of provided bids, experience of the private entities and the results of negotiation with the selected private entity. This allows arguing that many advantages of PPP are dependent on many factors, require appropriate knowledge and strong procurement skills from the PPAs to be assessed properly. Literature is rich in examples demonstrating a lack of competence in the public sector to procure PPP. Moreover, there are a number of analyzed disadvantages of PPP, which must be offset by the benefits available to get from private participation, to make the PPP valuable to proceed. Unfortunately, the analysis allows stating that literature provides only fragmentary solutions to how this task can be solved as well as how the possibilities of PPP to optimize investments in public infrastructure can be properly assessed.

Since the developed conception of optimization primarily requires comparing the best available CP and PPP options, the main aspects of structuring of PPP needed to be analyzed. The analysis revealed that, since PPP as a structure which combines PPA, investors, subcontractors and financiers and has to compromise their different interests, is very complex and includes many analyzed aspects to be

assessed and structured in such a way that would provide VfM for the public sector, it can be called a challenging and demanding process. The analysis of literature allows stating that it is limited in solutions which could suggest tools allowing to complexly solve the issues related to structuring of the best available PPP and rational-to-compare CP options.

The third major section, which discussed the theoretical aspects of VfM assessment allows stating that VfM assessment, which compares the value and cost of IP's delivery options in a structured manner, is used as the main decision-making tool to support decisions on whether to deliver the IP of public infrastructure and services through the PPP. However, the very conception of VfM assessment is highly complex, including many elements of both quantitative and qualitative assessment, from setting of the appropriate FDR to non-valued benefits, which are highly discussed and can be used differently, depending on the approaches applied, which also have their advantages and disadvantages. This allows arguing that, on the one hand, this determines the concept of VfM assessment for PPP as being very flexible and able to be adapted depending on requirements. On another hand, this means that the results of VfM assessment, since they highly depend on the assumptions used and the preconceptions applied, are rather subjective and, therefore, highly criticized for these aspects. For greater objectivity and reliability of the results, the analyzed literature demonstrates how important it is to ensure consistency and logic validity throughout the entire process of VfM assessment and its separate elements. However, the same literature regarding the application of a complex approach and, especially, the development of a practical solution is very limited, mostly focusing on separate elements of VfM assessment instead.

The analysis of fragmentary literature regarding the quantitative VfM assessment methodologies allows concluding that the main methodological reasons for differences in the results between the CP and PPP options are due to such aspects as the adoption of different FDRs for the CP and PPP options, the assumptions about higher efficiency of the private subject expressed in lower costs of the PPP option or higher costs of the PSC and the effect of time preference making the PPP option cheaper from the perspective of present value. Which of them effects the results depends on the approach applied. However, the analysis allows arguing that all approaches regarding VfM assessment at the stage of preparation tend to apply assumptions which determine particular artificial advantages of PPP against the CP and effect VfM accordingly.

Finally, the third major section concludes with an analysis of the factors important to increase VfM. It reveals that the complexity of PPP as a procurement option and the very concept of VfM determine the existence of many various CSFs need to be considered to achieve VfM. They cover many different aspects and can be distinguished into at least five main groups as well as different perspectives of the public sector, the private sector and the society, or users, regarding their preferences can be identified. Since these different priorities are difficult to be compromised from various stakeholders and there are many aspects to be evaluated, the assessment of PPP's possibilities to optimize investments in public infrastructure and services is a demanding and challenging task.

The first part of the dissertation, which analyzed the theoretical aspects of the assessment of PPP's possibilities to optimize investments in public infrastructure, allows the conclusion that, although the PPP as an alternative way of implementing public investment and deliver public infrastructure and services is becoming more and more acknowledged both in theory and practice, many aspects related to its implementation and assessment and maximization of its benefits are still explored only fragmentarily which aggravates its practical adoption and further development. The existing literature focuses on the analyses of separate aspects and on the maximization of individual goals. However, the PPP, being very complex in nature, requires applying a complex approach asserted by assessment of multiple aspects, a combination of many different interests and finding halfway solutions, which makes it challenging and demanding to be successfully implemented and at VfM, what is a serious lack in the existing literature. The analysis of literature allows stating that there is a lack of analyses where these particularities would be fully disclosed and converted into integrated solutions demonstrating a complex approach to the assessment of PPP's possibilities to optimize investments in public infrastructure and allowing to maximize VfM for the public sector. Regarding the complexity, there are no papers which would complexly analyze the structuring of a rational-to-compare model of the public sector and the optimal PPP model as well as the very VfM assessment. It is also limited in the analysis of aspects concerned with finding paths of information acquisition and processing towards win-win solutions acceptable to both the public and private parties as they are crucial aspects for the construction of a successful PPP. Accordingly, the results of theoretical analysis allow concluding that the existing methods and tools are limited in possibilities and insufficient to complexly assess the PPP's possibilities to optimize investments in public infrastructure and maximize its benefits for the public sector.

As a result, the scientific problem raised in this dissertation could not be solved entirely by the theoretical analysis provided in the first part of the dissertation and requires further actions of research. Therefore, to decrease the gap between the existing theory and practical needs, the second part of the dissertation, considering the theoretical background, is intended for the development of a methodology and the model for assessing the possibilities of PPP to optimize investments in public infrastructure.

2. FORMATION OF A MODEL FOR ASSESSING THE POSSIBILITIES OF PPP TO OPTIMIZE INVESTMENTS IN PUBLIC INFRASTRUCTURE

Given the results of literature review, this part of the dissertation, is committed to the development of the model for assessing the possibilities of PPP to optimize investments in public infrastructure with regards to the identified issues. It focuses on factors that have been previously identified as important to be assessed or considered in order to understand the costs and revenue streams of potential PPP IP, so that it would allow making reasoned long-term decisions by answering questions of whether a particular IP is viable, and if so, whether the government or the private sector should finance and implement it; and if the private option is chosen, how to maximize the benefits available to get from such partnership to the public sector. Since there are many factors which have impact on the possibilities of PPP to optimize investments in public infrastructure, the methodology and model are developed through various analyses along the overall PPP's project cycle, where the possible solutions for problematic aspects of assessment at different stages are discussed. Table 2.1 summarizes the methodological gaps identified in literature regarding the assessment of PPP's possibilities to optimize investments in public infrastructure, which require to be fulfilled by performing new researches and providing appropriate insights to reach the aim of this dissertation. Moreover, it shows the scientific novelty of the dissertation regarding the research topic.

Table 2.1. Identification of requirements for further analyses (prepared by the author of this dissertation)

No.	Limitations found in literature (considering I part of the dissertation)	Requirements for further analyses and researches
1.	The PPP is a complex way of IP implementation; however, literature is fragmentary regarding the initial aspects needed to be satisfied for rational and reliable assessment for PPP's possibilities to optimize investments in public infrastructure.	The analysis of preparatory conditions and assumptions for the assessment of PPP's possibilities to optimize investments in public infrastructure. More specifically, it needs to be focused on the determination of proper FDR and the assessment of risks.
2.	In the research field of PPP, literature is mostly focused on the very PPP IP, leaving a shortage of analysis regarding the transition from the public option of IP implementation to the delivery of infrastructure and services as PPP.	Identification of expediency criteria for the analysis of PPP's possibilities to optimize investments in public infrastructure.
3.	Fragmentary literature on how to structure the public sector's IP which are rational to compare against the PPP option.	Development of methodology for proper structuring of the PSC model which is rational to compare against the PPP option.
4.	Literature is full of analyses of various aspects of PPP structuring; however, it is weak in their systemization regarding a successive structuring of the PPP option.	Development of methodology for structuring the financially viable and optimized PPP.

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Continuation of Table 2.1

5.	Literature is mostly confined to the VfM assessment in social-based PPP IPs, leaving aside the economic-based PPP IPs. Moreover, there is a lack of analysis regarding the assessment of VfM for different beneficiaries.	Development of methodology for VfM assessment for both social- and economic-based PPPs also considering different beneficiaries.
6.	Literature discloses a lack of tools allowing the PPA to assess the possibilities of PPP to optimize investments in public infrastructure.	Development of integrated model allowing the PPAs to assess possibilities of PPP to optimize investments in public infrastructure and maximize the befits for the public sector.

Considering the above-identified the requirements for further analysis, this part of the dissertation continues with two major sections; the first one is intended to provide methodological justification for the development of an integrated complex model for assessing PPP's possibilities to optimize investments in a public infrastructure. While the second one, based on results of the methodological analysis, develops a model enabling to do this assessment.

2.1. Methodological reasoning for the model for assessing the possibilities of PPP to optimize investments in public infrastructure

Methodological justification for the model for assessing the possibilities of PPP to optimize investments in public infrastructure starts with the analysis of a process of selecting PPP IP, where the preparatory conditions which need to be satisfied are reviewed in order to identify candidate IPs for PPP potential, and the criteria enabling to understand whether additional funds should be spent on a full analysis and preparation of these IPs are provided. Further, the aspects and steps of designing the PSC model and the shadow bid PPP model are analyzed. Finally, methodological aspects of the VfM assessment are analyzed.

2.1.1. Preparatory conditions for the assessment of PPP's possibilities to optimize investments in public infrastructure

As disclosed in Section 1.3.1, since the assessment of PPP's possibilities to optimize investments in public infrastructure generally seeks to compare the CP option of delivery of public infrastructure and service against the PPP option, and find the most beneficial for the public sector to proceed, this primarily requires constructing the CP option which would be rational to compare against any other option with the appropriate involvement of private participation. It determines that choosing the best quality public IPs which offer the most socio-economic benefits is a key element for any further rational analysis for their PPP potential and, therefore, requires a lot of attention and efforts from the PPAs to do right.

Given the above-mentioned requirements, the CBA or cost effectiveness analysis (CEA) is usually used as a systematic approach for calculating and

comparing all benefits and costs[36] of possible alternatives to find the one that provides the best approach to achieve benefits while preserving savings. Both of these analytical frameworks refer to the following list of underlying concepts (CPVA, 2014a; European Commission, 2014b):

Opportunity cost. Since the opportunity cost of good and service in the public sector is defined as potential gain from the best alternative forgone, it is rational to assess inputs, outputs and external effects of IP's alternatives at their social opportunity costs in order to evaluate the return calculated as a proper measure to assess IP's contribution to social welfare.

Long-term perspective. In the context of infrastructure investments, usually the long-term perspective is applied ranging from 10 to 30 years or more, depending on the economic life of investments and the sector of intervention. This requires setting a proper time horizon, adopting the appropriate FDR for calculating the present value of future costs and benefits and considering the uncertainty by assessing the IP's risks.

Monetary-based. All positive and negative welfare effects of the intervention are expressed in monetary values, discounted and then totaled for calculating a net total benefit measured by indicators expressed in monetary values, which allow comparability and ranking of competing IPs or alternatives of IP's implementation.

Microeconomic approach. The assessment of the IP's impact on society and economics is confined by the measurement of direct employment or external environmental effects reflected in the ENPV and ERR, while indirect or, in other words, secondary market and wider effects are excluded for potential risks of double-counting the benefits.

Incremental approach. All scenarios with-the-IP are compared against the counterfactual scenario presenting what would happen in the absence of the IP, since both assessment frameworks only consider the difference between CFs in the with-the-project and the counterfactual scenarios.

The integrated application of these concepts generally enables the PPAs to prepare an IP, which allows assessing the welfare changes attributable to it. As basic concepts, they are listed and explained in the CBA guides (CPVA, 2014a; European Commission, 2014b; New Zealand Treasury, 2015). The reasons why these concepts have also been reviewed here is, first, to emphasize that the reliability of the assessment of PPP's possibilities to optimize investments highly depends on the early phases of IP's development, where the use of inappropriate principles or mistakes can have significant negative impact on the reliability of the results of future assessment for PPP's potential, and the second reason is that for the comparison of the CP option with the PPP option, some changes of these concepts have to be implemented. But they can be rationally discussed only when the main steps of conceptual framework of a standard CBA are reviewed in respect of selecting the most rational alternative to assess for PPP potential.

[36] In case of CEA, only the relative costs of different courses of action at a determined level of outcomes (effects) are compared. The determined effects are the main feature of CEA which distinct it from CBA, which assigns a monetary value to the measure of effect.

The standard framework of CBA consists of 6 main steps, which are as follow: 1) Description of context; 2) Description of content; 3) Option analysis; 4) Financial analysis; 5) Economic analysis, and; 6) Risk assessment, which are reviewed in more detail.

Description of context. Typically, the description of IP's context starts with the requirement to describe the social, economic, political and institutional context in which the IP will be implemented. Accordingly, the analysis is focused on appropriate aspects which are described, e.g., in the CBA guide issued by the European Commission (2014b). They are mostly related to IP's external environment that is important to disclose the overall context of IP; however, they are lacking concentration on the analysis of services, their quality and conditions of provision, with regards to the development of which, in respect of their accessibility, quality and efficiency of provision, the IP is prepared and implemented. This determines that under these methodologies a lot is required from the analysis of external environment, but with relatively little explanation on how they are linked to the analyzed services and how they affect them. They are lacking focus on the links of IP's problem to the services, i.e. their insufficient accessibility, quality and inefficient provision. As it is disclosed in Section 1.1.1.1, this aspect is very important, since the developed infrastructure and obtainable items are considered as only means for problem-solving, but not the problem, as what might seem in case of them being aged and obsolete. When the problems are related to services, it is analyzed which means can suggest the most advanced ratio of benefits and costs, which creates a basis for efficiency in the public sector. If IP's problem arises from an aging infrastructure, then, considering a causal relationship between the problem and the objective, the latter has to be focused on the improvement of infrastructure, which can be ineffective, if other means, e.g. even those not requiring any investments, can provide more benefits in comparison. Therefore, the analysis of external environment through the prism of services as well as the rise of problems from them are the key elements in the first part of CBA framework for the development of an efficient IP and further assessment for its PPP potential.

Description of content. The second major step of appraisal aims to describe the internal content of an IP. It consists of such elements of an IP as the purpose, objectives, links with other IPs, limits, results, etc. Since their description can be found in various CBA guides, only the elements to which specific insights regarding the PPP are provided are reviewed in more detail. They are IP's purpose, objectives and results.

Considering the importance of analyzing IP's external environment through the context of services, the purpose is logically required to be focused on the improvement of service provision in respect of accessibility, quality and efficiency. Developing a coherent logic, the objective of an IP should be to ensure the infrastructure needed for the provision of appropriate quality and accessibility of services, because such formulation of the objective does not block the way for a rational assessment of alternatives for IP implementation. Finally, the main results should be related to the minimum requirements for the delivery of services and minimum IP's impact on society, which must be achieved or exceeded in all

analyzed alternatives. The proper formulation of all elements lay the foundations for rational solving of the problems and possibilities to form rational alternatives, from which the one with the highest social-economic value can be chosen, which is a basis for any comparative analysis against the PPP option.

Option analysis is a crucial element of appraisal for finding the solution which could provide the most benefits for society and, therefore, be rational to be considered for PPP potential. Considering the difficulties of the public sector to ensure sufficient competence regarding the preparation of IPs, (see Section 1.1.1.), a good practice to systemize this analysis by enforcing a pre-defined list of the must-analyze alternatives[37]is observed. Since this compulsory requirement is included in the methodology, there is a lesser chance that available useful solutions are not considered for solving of the appropriate problems. Various lists of alternatives can be suggested depending on the starting position regarding the means envisaged to solve a problem. Alternatives for buildings, engineering infrastructure, equipment, transport equipment and intangible asset depending on whether they are wanted to be built or obtained rehabilitates and improves, changed, rented, etc. at the beginning can be asked to be analyzed for finding the best one in respect of socio-economic value. The results of option analysis directly affect what is rational to be assessed against the PPP potential and what forms and schemes of PPP, analyzed in Section 1.2.2., could be the most rational for cooperation with the private sector. This can mean that the best solution for problem-solving and implementation of an IP may not require investments in any infrastructure. This is the reason why the assessment of PPP's possibilities to optimize investments in public infrastructure has start from the beginning of IP preparation and why the preparatory conditions of analysis for PPP potential are analyzed in this dissertation.

Financial analysis. Since all the options rational for further analysis are identified, their financial analysis should be performed. The forth major step of appraisal aims to calculate and compare the total costs of different options of IP implementation. Since they are characterized by different CF profile over time, the DCF method is usually used. This requires adopting an appropriate FDR as well as other appropriate rules. Since they highly affect the results of assessment, there is great attention paid to them in this dissertation.

Reference period. Since the CBA assesses the impact of investments on the provision of services, CFs of IP need to be forecasted considering the IP's time horizon (reference period). Accordingly, the selected time horizon highly affects the appraisal results. Since the government usually does not seek profit, the most

[37] European Commission (2014) has issued a guide to CBA where only an explanation regarding different levels of option analysis as well as recommendation with good practices and common mistakes are provided. This determines that there is a responsibility of developers of IPs to select those options for analysis, which enable them intentionally or unintentionally not to include some options into the analysis and in this way to manipulate the results of assessment. Considering this issue, a list of must-analyze alternatives for IP implementation was decided to be developed in Lithuania (CPVA, 2016), one of the developers of which is the author of this dissertation. However, this example is still more an exception than a rule in public sector among the countries.

rational way is to equate the reference period to economic life of investments. For example, the European Commission (2014a) provides recommendable guidelines for determination of the appropriate reference periods at different economic sectors, which, depending on the sector, can range from 10 to 30 years. The determined period is the maximum period rational to use for the assessment of PPP's possibilities to optimize investments in public infrastructure.

Adoption of appropriate FDR. As it is indicated in Section 1.3.1., the adoption of the appropriate FDR is a complicated task and has to be accomplished, since there is no a single solution regarding this issue, considering the particular requirements and/or the approach applied, under which the advantages and disadvantages of lower or higher FDR could be assessed as well as solutions regarding its adoption could be made. Although the adoption of proper FDR is one of the most discussed scientific topics in the context of public investments, the practicians usually have low possibilities for individual initiatives and calculations, since the entire process of appraisal is determined by strict rules in various CBA guides and regulations, which have to be considered to get financing from the public funds. This determines that the promoters usually apply the FDR provided by governments instead of being concerned with calculating the individual FDR of IPs. The CBA guides (CPVA, 2014a; European Commission, 2014b) typically are very weak in methodological justification of the appropriate FDRs suggested and are more focused on the practical aspects of its application instead. Their analysis allows arguing that: first, despite of which of the approaches is applied, the FDR varies in the range between 3%–6% that can be considered as a particular guideline for orientation; second, in order to decrease the uncertainty related to future CFs, the financial analysis is recommended to be carried out in constant (real) prices, although the nominal prices could also be used, since a forecast of consumer price index (CPI) is not a problem, and; third, for practical reasons, the same FDR is usually applied to the entire country's public sector or, at least, to one of the economic sectors. In the latter case, in the sectors marked by higher risk, mostly these are the sectors where income from the direct users is collected, the higher FDR is emphasized in comparison with the sectors where demand risk is lower. These aspects show the context and some rational practices of adopting FDR in practice; however, they are lacking methodological guidelines of how the suggested FDR has been grounded and how to calculate it, if some adjustments, e.g. for the calculation of specific FDR for the appropriate economic sector, need to be done.

In some countries, e.g. in the member states of the EU, under Commission Delegated Regulation (EU) No 480/2014 (European Commission, 2014a), the same real FDR of 4% is used as an indicative benchmark for public investment operations co-financed by the European structural and investment funds (ESI funds in the period 2014–2020. There are also examples such in Lithuania, where this FDR provided by the EC is used in each of the cases, irrespective of whether IP is financed from the EU funds or exclusively from the country's national funds. On the one hand, such practice when the same FDR is universally applied during an appropriate period can be justified for reasons of administrative simplicity and convenience. Since the technical analysis of public sector discounting is complex,

for its successful application, the discounting conventions should be expressed in simple terms, which could be understood by officials even with no technical background. According to Spackman (2001), the best approach, if it is politically feasible and technically defensible, is to have a single number expressed in real terms, which is the government's discount rate and would represent its cost of capital. Accordingly, it is observed that countries are more likely to use one FDR, than to have several FDRs for different economic sectors because it is difficult to manage a system, in which more than one number is used by any single organization (except for occasional special cases). This number is usually used for the government and public enterprises.

On the other hand, since the FDR of 4% is generally applied for all EU countries, it does not reflect the particularities of individual countries. Therefore, to develop a reliable framework for the IPs' preparation and appraisal, it is relevant to adopt the country-specific FDR. Moreover, considering the tendency of decreasing the financial support to the new member-states from the EU, there is a need to develop long-term financing and evaluation instruments, which in the future would be independent from the ESI funds[38]. One of these instruments is the effective IP appraisal framework. Since the FDR is one of its key elements, it is important for the member states to determine reasonable FDRs, which would reflect each of their particularities accordingly.

The scientific literature basically distinguishes two main approaches to determine the FDR: first, based on long-term borrowing rate of the government, and; second, based on alternative cost of private capital (market price). Both methods are further analyzed in more detail.

When the FDR is equated to government's borrowing rate, it reflects a risk-free rate of return. The main argument supporting this method is that, since governments hold a large and diversified portfolio of IPs, the systemic risk has no or relatively insignificant impact on their return, i.e. the marginal return from public investment, overall, is virtually risk-free and, hence, can be evaluated at the risk-free rate rather than the higher market rate demanded by less diversified individuals (Lucas, 2012). Therefore, government's cost of borrowing capital can be used as the FDR of the public sector. Since a pure risk-free rate of return is considered as a rather theoretical rate, i.e. even the safest investments carry a very small amount of risk, both in theory and practice a risk-free interest rate is usually equated to interest rate on government securities. Here, it should be noted that not all national securities can be considered as risk-free. Once again, this lesson has been learned during the financial crisis of 2009–2011. The existence of government default risk can aggravate the application of this method based on government's borrowing rate. As a result, it can be used if there are no default and reinvestment risks. This determines

[38] Moreover, as set out in Article 19 (Discounting of cash flows) at Commission Delegated Regulation (EU) No 480/2014, every country can determine its own DR if it is justified properly. Accordingly, values other than 4% may be justified on the grounds of: (a) the Member State's specific macroeconomic conditions and international macroeconomic trends and conjunctures; or (b) the nature of the investor or the implementation structure, such as public private partnerships; or (c) the nature of the sector concerned.

that the risk-free rate will vary only depending upon the period over which the return wants to be guaranteed. Both academicians and practicians usually equate it to the interest rate of long-term government bonds. There is a practice to choose securities, the maturity of which would be as close as possible to the IP's reference period. According to Damodaran (2008), a rate of 10 years government bond is most prevailing. Since over the past several years 10-year bond yield hit record low interest bond, to determine the individual FDR, it is expedient to use not the latest available data, but the average of government bond yield during a 10-year period (Eurostat, 2017).

The proponents of FDR equated to alternative cost of private capital argue that public borrowing rate and country's alternative cost of capital are two separate things and, therefore, should not be equated in respect of discounting risky investments. The main argument is that when a government funds risky investments by selling safe debt securities, risk is shifted onto the current and future taxpayers and other government stakeholders, who effectively become equity holders in a risky investments (Fleurbaey & Zuber, 2015; Kellermann, Fleurbaey, & Zuber, 2007; Lucas, 2012). From the perspective of a taxpayer, the gain is offset by the cost of the associated market risk. If the stock market performed well, the government would be able to pay back the debt and use the surplus to lower taxes or increase other spending. If the stock market did wrong, the debt would still have to be repaid, either by raising taxes or cutting other spending. Hence, government debts are hedged by tax payers' money. Moreover, the taxpayers who make the same investments on their own would expect the positive return as compensation for the assumed risk. Therefore, for the determination of FDR, an alternative cost of tax payers' capital should be used rather than the cost of government borrowing. Especially when government's investments also have private sector analogues and are subject to aggregate risk, e.g. government-owned central heating for houses facilities have a similar exposure to demand shocks as do private utilities. Therefore, government's investments have to assess the factor of systemic risk (Lucas, 2014).

Accordingly, the absence of this factor determines the main critics to the application of cost of public borrowing for discounting. According to Lucas (2012, 2014), the most significant hazard for governments using a risk-free rate (or their own borrowing rate) for discounting is that it creates a money machine for politicians who benefit from being able to show government investments that are popular among constituents as profitable. The same scientist appeals to the knowledge of government analysts, who, due to various reasons mentioned in Section 1.1.1., do not appear to recognize the physical impossibility of financing risky investments with risk-free government debt, thereby failing to realize that the taxpayers are equity holders in risky government investments. This problem can be partly explained by the insight that, since the regime of cash-accounting is dominant, interest is visible cost but the risk-bearing by taxpayers is not.

For the realization of requirement to apply market price for discounting, literature (Armstrong, Knif, Kolari, & Pynn?nen, 2012; Baek & Bilson, 2015; Majumder, 2013; Pandey & Sehgal, 2017) suggests various models: the model based on Arbitrage pricing theory, Gordon growth model, Fama–French three-factor

model, etc. However, the CAPM, due to its simplicity and relative easiness to use, is the most prevailing both in theory and practice. For example, a survey in the USA disclosed that even 15 years ago 73.5% of respondents calculated the cost of equity capital with the CAPM (Harvey, 2005). While the literature review disclosed that in theory there are many different approaches/methods of CAPM, in countries like the USA, all these different methods often yield similar results. However, the problem is that when it is moved outside of the USA, particularly into developing markets, different methods can produce widely varying results. Therefore, the questions related to the investigation of the most appropriate method of discounting, in particular cases, still attract much attention in the context of FDR determination. Since extensive reviews of CAPMs and their internal assumptions have been provided by Copeland (2014), Gözen (2013), Harvey 2005, Tomaševič (2010), only the main aspects of its application are discussed in this dissertation.

The CAPM describes the relationship between systematic risk and expected return on risky assets. According to Tomaševič (2010), for the adoption of CAPM the following assumptions have to be satisfied: 1) Investors are reluctant to take risks and seek to maximize gains of assets; 2) None of the investors have a dominant position in the market; 3) All investors have the same time horizon of investment decision; 4) All decisions are taken by the investors considering only two criteria: return on investment and risk; 5) There is a risk-free rate of return and each investor can borrow or lend an unlimited amount of funds in accordance with the rate charged; 6) Capital can be invested to all types of investment at a desired ratio; 7) There are no transaction costs, taxes or other restrictions for purchasing and selling; 8) Information is equally receivable to all market participants.

The general idea behind CAPM is that investors need to be compensated in two ways: time value of money and risk. Accordingly, the common CAPM formula (Formula 1) for calculating the expected return of an asset given its risk consists of two main parts: the first one assesses the time value of money and is represented by the risk-free rate (R_f), which is considered as a rate of return on investment with zero risk, and the second one represents risk and calculates the amount of compensation the investor needs for taking on additional risk regarding particular investments.

$$E(R_i) = R_f + \beta_i(R_{ma} - R_f) \qquad \textbf{(1)}$$

here: R_f – risk-free rate; β_i – beta of security (risk measure); R_{ma} – expected market average return.

The second part of the formula attracts the most scientific attention. It is calculated by taking a risk measure (β_i), which compares the return on an asset to the market over a period, and the market premium (R_{ma} - R_f), which is considered as the excess return of the market above the risk-free rate.

β_i coefficient is one of the most important factors of CAPM and reflects how risky an asset is compared to the overall market risk. The higher β_i is, the more return depends on the systemic risk factor (RF) on particular investments. Accordingly, CAPM is based on the internal assumption that investors emphasize rational behavior and can eliminate non-systemic risk by diversifying their

investment portfolios. CAPM assesses only systemic risk which affects the entire market and cannot be eliminated.

Generally, β_i is a function which can be expressed as covariance of expected return on the capital asset and expected return of the market divided by a variation of expected return of the market, or as correlation of expected return on the capital asset and the market divided by a ratio of standard deviations (SDs) of the same expected return on the capital asset and the market (Formula 2).

$$\beta_i = \frac{Cov(R_i R_{ma})}{Var(R_{ma})} = cor(R_i, R_{ma}) * \sigma_i / \sigma_{ma}; \quad \textbf{(2)}$$

here: R_i – expected return on the capital asset; R_{ma} – expected return of the market; σ_i – standard deviation of expected return on the capital asset; σ_m – standard deviation of expected market return.

Since the classical CAPM, due to its assumptions that more reflect the idealized rather than real situation, has been highly criticized, over the past few decades, various scientists have developed many alternative CAPM-based models. The choice of the most appropriate model largely depends on the integrity of the national security market with the global market. Based on the correlation level between national security market index and global security market index, CAPM-based models can be classified into three main groups (Thapa, 2007):

1. Totally-segmented – only the factors of a particular country are assessed;
2. Partially-integrated – factors of a particular country and global market are assessed;
3. Fully-integrated – the assessment is based on the global market's factors.

In case the market is totally segmented, the investors assume risk that is affected only by the factors of a particular country where investments are implemented. In contrary, when the integrity of national market with the global market is high, investors cannot be expected to compensate for particular country's risk, because it is fully diversified. In this case the investors face the factors of the global market. However, since both cases are rather marginal, i.e. nowadays markets usually are neither totally segmented nor completely integrated, the problem of how to assess cost of private capital in a partially integrated market attracts the most attention from both the theoreticians and practicians.

Scientists have developed many versions of CAPM-based models fitted to use in a partially integrated market. However, their application in practice is already rather complicated in the private sector. The attempts to apply them in the public sector at the level of a country are even more challenging. For example, Gözen (2013) has reviewed 16 versions of CAPM-based models for developing countries, and Harvey (2005) has provided an analysis of 12 different versions of CAPM-based model.

On the one hand, since there are many versions, as provided in Appendix 6, it is a difficult task to choose the most appropriate one, especially, if the choice is done at the level of CAPM elements. On the other hand, there are some fairly universally-

accepted practices. The analysis of these models disclosed that, regarding a risk-free rate, it is usually equated to the rate of national government securities denominating in one of the global currency (e.g. USD, EUR, JPY). Regarding the expected return on market, it is equated to the average return of one of global market indexes (e.g. S&P 500, FTSE, Nikkei).

The most variations regarding CAPM-based models are related to β, although in principle, most scientists use Formula 2. The issue related to the calculation of β is that most of these models are primarily adjusted for calculation of return rate of particular investments and, therefore, are complicated to apply country-wide. Considering this issue, Reyent (2008) suggests to use average return rate of national stock market index. Then β can be calculated by using Formula 3.

$$\beta_i = cor(r_l, r_g) * \sigma_l/\sigma_g \quad \textbf{(3)}$$

here: r_l – local market index return; r_g – global market index return; σ_i – standard deviation of local market index return; σ_g – standard deviation of global market index return.

Gözen (2013), who quoted other researches, states that most of developing countries' βs are lower than 1, since their level of capital market integrity with the global market is lower and, therefore, the correlation between the indexes of national capital market and global capital market is lower. This determines that risk premium becomes unjustifiably low. Considering this issue, the same scientist provides a modification of Formula 3 where only the ratio of σ_i and σ_g is left (Formula 4), which, considering the fact that β and country risk premium can at least partially duplicate to each other, is adjusted by the coefficient equated to 0.6. This value is grounded by the research according to which capital market fluctuation can explain no less than 40 percent of risk.

$$\beta_{i(ad)} = 0{,}6\frac{\sigma_l}{\sigma_g} \quad \textbf{(4)}$$

In contrary to the developed countries, the developing ones are riskier. Therefore, to calculate the FDR for the developing countries an additional country risk premium R_c has to be added, as suggested by most scientists whose CAPM-based models are provided in Appendix 6. Damodaran (2017), and Naumoski (2012) distinguish the following alternatives to measure country risk premium:

1. *Country's sovereign credit ratings assigned by a relevant credit rating agency*. These ratings measure the default country risk rather than equity risk. On the one hand, since both risks are to some extent influenced by the same factors (e.g. currency stability, budget and trade balance, political stability), this measure can be considered as an approximately correct measure of country risk. On the other hand, the focus on default risk by ignoring the rest of the factors that could influence the equity market is also a major issue with this option. Moreover, the rating agencies often do not completely reflect expectations about the future. Their decisions are more based on historical data; therefore, they lag to reflect the changes in country's

default risk. Their assessment methodology is also not publicly available, which determines a lack of transparency with these ratings. Finally, credit rating agencies do not provide ratings for all countries.

2. *Bond default spread*. This measure reflects the spread between the yield to maturity of an emerging market sovereign bond denominated in US dollars or EUR and the yield of a comparable USA or euro bond, respectively. For rational comparison, both securities must be issued in the same currency and have equal maturity. This method to measure country risk premium is widely considered to be a comprehensive measure of a country's overall risk premium, stemming from market, credit, liquidity, and other risks. However, the issue with the application of this method is that both measures lack data, since not all countries issue sovereign bonds denominated in one of global currency.
3. *Credit default swap (CDS) spread*. This is a measure similar to the case of bond, however, since CDS markets are, in comparison, more updated and more precise, which the advantage of this method. However, since it is sensitive to market information, and even investors' sentiments that are unrelated to the underlying country risk fundamentals, it can be also more vulnerable. Moreover, this measure also faces the problem related to the lack of data, especially with regards to the emerging countries.
4. *Equity market volatility* is also sometimes seen as a good measure of country risk premium, where volatility is usually higher in the market of the developing countries than in the market of the developed countries. However, market volatility is to a large extent a function of market liquidity. Markets that are risky and illiquid often have low volatility. Therefore, due to low liquidity in some period, volatility could be understated and, by contrast, volatility could be overstated in a period of great liquidity that, in turn, determines the reliability issues of this measure.

The pro and con arguments related to each of the above-mentioned methods allow arguing that the possibilities and rationality to use an appropriate method to evaluate country risk premium depends on many aspects, such as the level of country's development in respect of the economy and financial market, availability of data about the issued government bonds as well as other particular requirements.

The analysis of all the above-mentioned aspects related to calculation of FDR allow finally concluding that, if the CAPM approach is taken, the FDR for the developing countries and for the developed countries can be calculated by using Formulas 5 and 6, respectively.

$$E(R_i) = R_f^g + 0{,}6\frac{\sigma_i}{\sigma_g}(R_{ma}^g - R_f^g) + R_c \quad \textbf{(5)}$$

$$E(R_i) = R_f^g + cor(r_i, r_g)\frac{\sigma_i}{\sigma_g}(R_{ma}^g - R_f^g) \quad \textbf{(6)}$$

here: R_f^g – risk-free rate equated to country's sovereign bonds denominated in one of global currency, R_{ma}^g – average return of global market index, R_c – country risk premium, r_l – local market index return, r_g – global market index return, σ_l – standard deviation of local market index return; σ_g – standard deviation of global market index return.

Considering the analyzed features of both major approaches for the calculation and application of FDR, the process of choosing the most appropriate FDR can be represented by developing the following model (Figure 2.1).

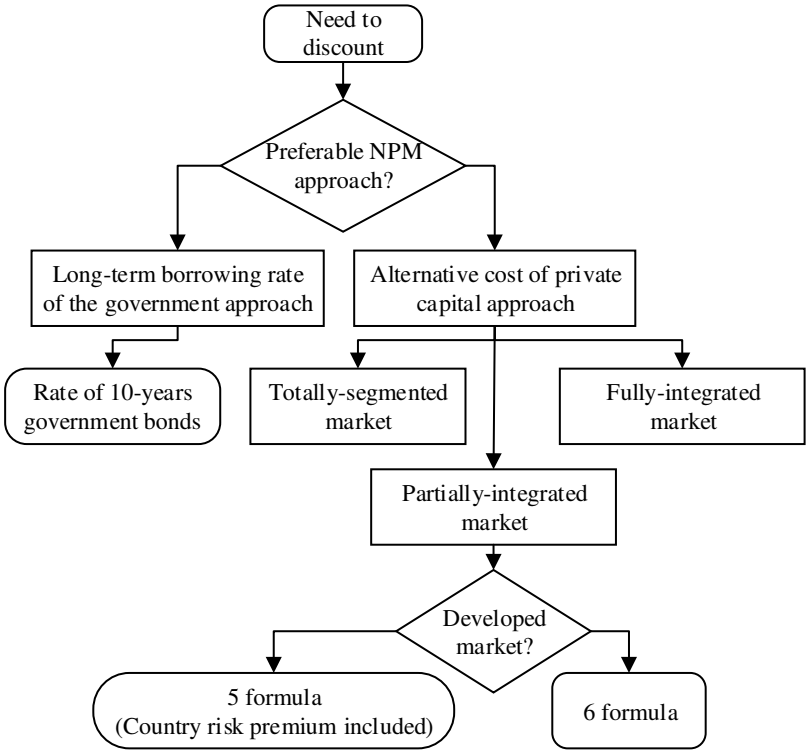


Figure 2.1. The model for calculating FDR of a country (prepared by the author of this dissertation)

The model shows that the way to calculate FDR depends on the subjective approach of government in respect of its policy of investment appraisal, since both approaches of long-term government's borrowing rate and the approach of alternative cost of private capital have their own arguments. Considering these arguments, the attitude of this the author of this dissertation is that if the government seeks to implement NPM methods and increase the involvement of the private sector in the provision of public infrastructure and services, then there are more arguments to apply FDR equal to the alternative cost of private capital. And, conversely, if the government is conservative regarding the methods of IP appraisal, then the

determination of the individual FDR has to be based on government's borrowing rate.

Calculation of financial indicators. Since the main options of IP implementation are identified, their financial analysis has to be done. There are six main CFs used for the calculation of key financial indicators:

1. **Investments**, which include the capital costs (capex) of all fixed assets, e.g. buildings, land, plant, machinery, equipment, cars, software, furniture, etc. and non-fixed assets, e.g. design/planning, project management and technical assistance, construction supervision, publicity, etc. Since investments into infrastructure wear out, a depreciation process must be assumed to account for replacement. Therefore, replacement costs occurring during the reference period to replace short-life machinery and/or equipment also have to be included.
2. **Residual value**, which reflects the capacity of the remaining services potential of fixed assets, whose economic life is not yet completely exhausted. It is included in the assessment at the end of reference period.
3. **Revenues**, which are cash in-flows directly paid by users for the goods or services provided.
4. **Operating costs**, which include all costs (opex) to operate and maintain the new or upgraded service from, e.g., labor costs and materials needed for maintenance and repair of assets to waste disposal costs or even environmental taxes, if applicable.
5. **Taxes**, which include VAT, customs duties and excise duties, if applicable.
6. **Sources of financing**, which include different sources of financing that cover the investment costs and operating costs to make the IP financially sustainable. The main sources of financing are grants, loans and bonds.
7. **Financing arrangement costs** are the costs associated with arranging the financing for the IP, generally with loans and bonds. However, it can also include items such as arrangement fees, commitment fees, and "swap" credit premiums. The processes of arranging financing and servicing the debt over the loan period can represent significant costs which, depending on the applied accounting standards, can also be incurred as part of the investment costs.
8. **Procurement costs**, which include costs related to public procurement.
9. **Public oversight costs**, which include costs related to the oversight of IP in order to protect the public interest.

When the above-listed FCs are determined regarding the assessment of financial profitability of the IP, financial NPV on investment (costs) ($FNPV_C$) is calculated which is defined as the sum that results when the expected discounted investment and operating costs of the IP are deducted from the discounted value of the expected revenues (Formula 7).

$$FNPV_C = \sum_{t=0}^{t=n} \frac{-I_t + RV_n + RE_t - OM_t - FAC_t - PC_t - POC_t}{(1+r)^t} \quad (7)$$

here: *CF* – cash flow, *r* – discount rate, *I* – investments, *RV* – residual value calculated at the end of reference period, *OM* – operating and maintenance costs, *RE* – revenue, *FAC* – financing arrangement costs, *PC* – procurement costs, *POC* – public oversight costs.

Considering the particularity of the public sector, there are many non-revenue generating IPs whose $FNPV_C$ is certainly negative and, to be financially sustainable, they require to be financed from the public funds, i.e. grants and subsidies have to be foreseen to make the IP financially sustainable. Accordingly, the IP is considered as financially sustainable, when the cumulated CF (CCF) balance between inflows and outflows remains equal to or above zero for all the years considered ($CCF \geq 0$). Inflows may include operating revenues from the provision of goods and services from direct users, various sources of financing, grants, subsidies, etc., while outflows are related to investments, replacement costs, operating costs, reimbursement of loans and interest payments, as well as taxes. They have to be managed in a way that would ensure that there is no risk of suffering from a shortage of budget.

Economic analysis. To be socially-economically justified, an IP has to be assessed with regards to whether it contributes to welfare. This requires the following steps: 1) convert market prices to shadow prices; 2) assess direct benefits and externalities, and; 3) assess economic performance, which finally provides the answer whether, in general, the IP provides socio-economic benefits ($ENPV > 0$) and, if yes, which of the options is emphasized by the highest value. Accordingly, this option is chosen for the implementation of the IP and becomes rational for further analysis for its implementation under the PPP.

Risk assessment. As it is disclosed in Section 1.2.3, the implementation of IPs often faces the problem of planned cost overruns. Therefore, risk assessment is a crucial part of CBA to deal with the uncertainty and risks. It may consist of the following steps: 1) sensitivity analysis; 2) scenario analysis, and; 3) calculation of REs. The first two are widely acknowledged as assessment methods. However, the calculation of REs remains challenging and is widely discussed among both scientists and practicians in the context of assessing cost overrun risk in public IPs. Since the public sector tends to be criticized for a lack of accountability and transparency regarding the estimation of IP costs (Mutiganda, 2013) and, therefore, there is a demand for application and systemization of various techniques which would enable to increase the accuracy of cost estimation in the IPs, the assessment of cost overrun risk (Risk) is further analyzed in more detail, as the results of risk assessment are critical for a reliable assessment of PPP's possibilities to optimize investments in public infrastructure.

Many authors, such as Jorgensen et al. (2012), Tang, Wang, & Ding (2012) discussed the complexity of cost estimation process, especially in the construction IPs. Generally, the more complex the IP is, i.e. the amounts of investments are

larger, the number of investment objects is higher, technologies to be used are less proven, the duration of the construction phase is longer, etc., the more difficult it is to accurately estimate the investment costs. All these aspects determine the uncertainty, due to which there is always a risk that the estimated investment costs will be overrun. Therefore, the widely used method of cost estimation, i.e. predicting the construction costs and simply calculating that the total is deterministic and insufficient (Okmen & Oztas, 2010). The risk-adjusted cost have to be estimated (Zavadskas et al., 2010).

This Risk is related to a fact that, due to increased investment cost, the price of an IP can become so high that the promoter may face problems to secure additional financing to implement the IP and/or it may become financially and economically not worth to implement. According to Okmen & Oztas (2010), Tamosaitiene et al. (2013); Xu et al. (2010), Risk can be determined by various RFs, such as weather conditions, labor productivity, underground conditions, mistakes in the construction plan, changes of public sector requirements, etc. There is also a possibility that their variation may create and a positive effect, i.e. actual costs may be lesser than the forecast costs. Therefore, one of the major steps in cost estimation is to assess the potential risks and their RFs (Marhavilas, Koulouriotis, & Gemeni, 2011; Mousavi, Tavakkoli-Moghaddam, Azaron, Mojtahedi, & Hashemi, 2011).

Literature is rich in papers addressing risk assessment. Traditionally, despite the difficulties to obtain the objective probabilities and frequencies it is focused on quantitative risk assessment (Carr & Tah, 2001; Taroun, 2014), where investment costs are estimated usually using such simulation methods as Monte Carlo (Almarri & Blackwell, 2014; Du & Li, 2008; Loizou & French, 2012), at a particular level of probability, usually 70% (Mirdamadi et al., 2013)[39]. Funding of the public investment programs at this confidence level or above certainly raises the probability of a project being implemented successfully, but, naturally, requires a higher level of funding. These additional resources could be used for the implementation of other potential IPs. Therefore, to use resources efficiently it is important to accurately assess the potential overrun of estimated costs. This aspect is even more relevant in cases when the public sector goes into the PPPs and seeks to assess the value of transferred risks to the private subjects (Chen & Chiu, 2010; Demirag et al., 2011; Phang, 2007). The more accurately Risk is assessed, the better possibilities there are to rationally allocate it between the partners as well as arrange the financial conditions of partnership (Demirag et al., 2011; A. Ng & Loosemore, 2007). Also, the importance of accurate risk assessment for efficient risk management is acknowledged (Carr & Tah, 2001; Grimsey & Lewis, 2002; Marhavilas et al., 2011; Taroun, 2014).

During the last several decades, the theoretical models and computerized tools used for quantitative assessment of risk were developed widely enough (Marhavilas et al., 2011). However, there is still a wide gap between theory and practice. According to Muthuveloo, Pulenthiran, & Teoh (2013), many IP promoters simply

[39] Confidence level, that varies in the interval between 60% and 80% usually is used (Tecolote Research, 2007).

rely on subjective probabilities and in many cases risk is subjectively dealt with through adding an approximate contingency sum. Summarizing the studies about the actual practice of cost estimation in construction projects Taroun (2014) concluded that, in the managers' point of view, personal experience and subjective judgments were considered as the most effective and widely used technique for managing risks. According to the author, most promoters have not performed any form of statistical analysis of risk or used any sophisticated quantitative tools. Such reasons as: 1) the unique nature of every construction IP, due to which it is complicated to apply general probabilities; 2) the difficulties to get reliable inputs, and; 3) limited understanding as well as a lack of experience in such methods, were revealed as an explanation. This shows that although the quantitative methods of risk assessment, in principle, have a high potential to make them more usable, in practice they have to be easier understood and more convenient. Therefore, the simplicity and facilitation of practical experience are considered to be the key element of future development of quantitative risk assessment tools.

The development of a quantitative methods is also relevant in the context of researches, which disclosed that experts who use their personal experience usually underestimate the risk (Veres, 2009) and rarely can identify 60% of the possible uncertainty range and never did better than 70%, i.e. approximately one sigma (Capen, 1976). This shows that although the actual practice of risk assessment is very much based on qualitative methods and tools, their accuracy is rather limited. A complex application of quantitative and qualitative methods would the best solution in most of the cases.

Considering the above-mentioned issue related with the unique nature of every IP, the application of quantitative risk assessment methods in the public sector can be more pragmatic in respect of accuracy and transparency than in the private sector. In the public sector, a lot of IPs are implemented through various Public capital investment programs (PCIPs) and can be divided into separate project types. In each type, the nature of risk is very similar and the number of IPs is usually large enough to collect empirical data and apply general probabilities as well as the statistical tools for the assessment of Risk. For instance, the public sector implementing a certain number of typical secondary school renewal IPs under one of the programs is able to collect data from former IPs and use them as inputs for the quantitative assessment of Risk in the latter projects (Wu, Huang, Zhang, & Zhang, 2012). While in the private sector, the diversity of IPs is much higher and the number of the same or very similar IPs is usually lower. Therefore, in this respect, the public sector usually has more opportunities to use the advantages of the application of quantitative risk assessment tools.

Although the use of quantitative risk assessment techniques in practice is wrapped by many problems, literature is still poor in researches where they would be analyzed in the context of public investments. The particularities of Risk as well as the application of probability distributions (PDs) for the assessment of Risk in the IP are not the exceptions. One of the rare examples is the United Kingdom National Audit Office's reports, which revealed that only from a quarter to nearly a half of all IPs, depending on the year, have been implemented within the estimated budget

(National Audit Office, 2003, 2009). However, this fragmental information did not provide any quantitative data about the probabilities and values of risk. In most papers, such as those prepared by Acebes, Pajares, Galán, & López-Paredes (2014), Chou (2011), Jiang, Zhang, & Ji (2003), Scherer, Pomroy, & Fuller (2003),analyze the features of the so-called "traditional" PDs such as normal, triangular, lognormal, beta etc. to assess various uncertainties, but not their appropriateness to assess the Risk. The lack of these empirical data determines the problems to estimate the amounts of risk-adjusted investment costs as well as the choice of PDs enabling to describe Risk the best. Considering poor knowledge about the particularities of Risk and the PDs the best enabling to assess it as well as the requirement to facilitate the use of quantitative risk assessment tools, this dissertation focuses on finding the solution for the issue of what PDs are the most suitable to assess the Risk of public IPs.

Literature analysis allows arguing that the assessment of investment costs is more a forecasting exercise than a simple calculation of total investments. Numerous researches disclose a diversity of problems related with forecasting. Many factors, such as imperfect information, misleading assumptions, various errors, unpredictable changes in the IP, new or unproven technology, tendency for humans and organizations to favor optimism, etc. may cause deviations from the initial prognosis, due to which actual investment costs may vary in either an adverse or a favorable direction (Fischer et al., 2010; Hameed Memon, Abdul Rahman, Yasmin Zainun, & Abd Karim, 2014; Ke et al., 2010). Usually, this variation consists of a spectrum of respectively distributed potential values. The larger uncertainty is, the broader the spectrum may be. Therefore, Risk as a quantitative concept can be assessed by PDs indicating the likelihood of a variable of the forecast investments falling within the stated limits. As a result, although there is still some attempts to deny that risk can be quantitative, even in theory (Campbell, 2005), it is usually expressed in quantitative measures at a certain probability level or in the probability of occurrence of the desirable result, e.g. a particular probability that the IP will be implemented within the estimated costs.

The realized value and its probability of occurrence are two parameters needed to transform simple uncertainty into a defined risk. To do that, the PD of variables, i.e. a cumulative distribution function (CDF) has to be known. Depending on the particularity of risk and data available, several techniques can be used to get variables. In literature, the probability-impact (P-I) risk model is prevailing (Taroun, 2014). Such reasons as simplicity, flexibility, tendency to be cheap, empowerment to visually compare the risks and as a result easy understanding enable to explain its popularity (Bowers & Khorakian, 2014; Kmec, 2011). However, despite these advantages this model is also strongly criticized. Due to mostly used qualitative categorization, subjective ranking and impossibility to maintain perfect congruence between the qualitative and quantitative rankings, by using it for most of risks neither the probability nor the impact can be accurately quantified (Cox, 2008). Due to these reasons, the P-I model is flawed and should be used with caution.

The alternative way to estimate potential investment costs is the use of historical data, which can help to assess the risk more accurately, though this also

has some pitfalls. Mostly because historical data are not always available and firstly allows disclosing the risk experienced in the past. Meanwhile actual values may lie outside the range of historical records, thus critical risks may be ignored (Bowers & Khorakian, 2014; I. T. Yang, 2005). However, due to the same reason, it is justifiable to use historical data for the assessment of risk which may occur in the future, if it is expected that the observed past behavior will continue in the future (Makovšek, 2014). The papers by Gokiene (2010), Macário (2010a), and Tang et al. (2010) disclose that this assumption may be difficult to apply for the ex-ante assessment in the case of whole life-cycle costs, which consist of the investment costs as well as the long-term operating costs needed to forecast, e.g., in the complex IPs implemented as the PPP. But this might be much easier in the case of implementing very similar IPs, as in the example of renovation of the secondary school IPs mentioned earlier. In these cases, data obtained from former IPs allows envisaging the tendency of success in implementing this kind of IPs within the estimated budget which can be described by the appropriate PD (Rostami et al., 2013).

When historical data is used to assess risk, it involves an attempt to fit theoretical PD to the data and verify its goodness-of-fit statistically. For this purpose, usually such statistics as Kolmogorov-Smirnov, Anderson Darling, Cramer-von Mise, Shapiro-Wilk, Filiben, X2, etc. (Beaulieu, Dufour, & Khalaf, 2014; Heo, Shin, Nam, Om, & Jeong, 2013; Jiménez-Gamero, Alba-Fernández, Muñoz-García, & Chalco-Cano, 2009) are used, and the fitness is measured by quantifying the distance between the empirical and appropriate theoretical CDFs. The closer the distance is, the better the theoretical PD reflects a sample. In some cases, there can be many potentially suitable PDs; therefore, to avoid wasting time looking for the most suitable PD manually, the fitting process is usually done with software packages, such as Crystal Ball, EasyFit, @RISK, etc. A typical result is a list of statistically "good" PDs and their associated parameters, based on which the estimator of risk can select the most proper one.

However, although nowadays the derivation of PD is largely computer-assisted, the results can be widely different depending on inputs used. The estimator has to ensure the appropriate methodology to get meaningful results. In the estimation of costs there is a logical lower boundary of uncertainty, i.e. investment costs cannot be negative. Therefore, in practice it is discouraged to employ PDs that have values less than zero or to truncate the lower limit at zero for all PDs (Jiang et al., 2003). The second way is even less recommended because such truncation moves the mean of the PD to the right, making it a more conservative estimate. However, the estimator can be free to choose the best PD depending on specific requirements.

There is a rather limited number of studies which analyze the suitability of appropriate PDs under various conditions. In the papers of Acebes et al. (2014), Chou, Yang, & Chong (2009), Chou (2011), Jiang et al. (2003) such well-known PDs as normal, beta, triangular, lognormal, uniform, etc. are met and their suitability to reflect historical data is usually analyzed in the context of whole life-cycle costs estimation of the IP. These studies suggest that the lognormal PD could be the most appropriate and universal in this case. However, there is no more significant

information about PDs which are best able to describe the tendency of the public sector's success to implement IPs within the estimated budget and to assess the Risk.

Considering the above-mentioned issue, the author of this dissertation, in order to find the most suitable PDs to assess Risk in the IPs, has performed a research, in which a total of 853 public IPs implemented in Lithuania have been included for quantitative analysis. The research was based on a comparison between the estimated costs and actual costs of IP implementation, which resulted in an analysis of peculiarities of Lithuania-specific Risk[40] and finding the most accurate PDs with appropriate parameters for the seven following financial statements: 1) land (A1); 2) real estate (A2); 3) construction and other repairs (A3); 4) equipment and machineries and other assets (A4); 5) projection, technical maintenance and other services related to investment into A1–A4; 6) reinvestments into A3 and A4, and; 7) other services (A7), respectively. The research methodology is described in detail in the article prepared by Jasiukevicius & Vasiliauskaite (2015a). Since the results of the research are properly analyzed in the same article, only the main results related to the peculiarities of investment costs overrun in Lithuania and PDs allowing to describe the Risk are presented in the dissertation.

The research revealed that among various public IPs, the estimated investment budget was overrun by a quarter on average (25,6%), while the results in different groups of IPs have varied in a range from one-sixth to a little bit more than a quarter of the estimated investment costs with the marginal results in the group of equipment and machineries on the lower side, and construction on the higher side, respectively (Appendix 7). The results disclosed the presence of different levels of Risk in every group; however, only the difference of the results between the mentioned marginal groups was statistically significant among all 21 possible comparison options[41]. Therefore, only the phenomenon of IPs of procurement of equipment and machineries are likely to be less overrun than the IPs of construction can be statistically confirmed ($(p = 0{,}004) < (\alpha = 0{,}05)$). All results are based on the Mann–Whitney U test. These findings correlate with the results of 258 large transport infrastructure IPs covering 20 countries presented by Li Yin Shen et al. (2006), which note that cost overruns occurred in almost 90% of the IPs examined, with the highest cost overruns of 86% and 28% on average.

The analysis of peculiarities of Risk disclosed that the observed tendency of estimated costs overrun is not unambiguous. The results in quantiles show that a little bit more than 2/3 of all analyzed public IPs have been implemented within the estimated budget, 4/5 of which by fully using all planned assignations (Figure 2.2). On the one hand, these results could be explained by public sector's great efforts to

[40] The Risk was analyzed by calculating R (the ratio) between Ir (actual investment costs) and I_p (estimated investments costs) in the public IPs, where values, $R = (I_r/I_p)$, can vary in a range $[0; +\infty)$, where: R=0 means that no actual costs have been experienced; R=1 shows that the implemented IP has fully used all estimated budget, and; R>1 shows an overrun of the estimated budget. R<1 can imply savings in the IP or the result of underfinancing.

[41] Kruskal-Wallis test has indicated at least one statistically significant difference among the groups of IP in respect of their investment costs overrun tendencies ($X^2 = 12{,}865$, $(p = 0{,}012) < (\alpha = 0{,}05)$).

properly estimate the investment costs and implement the IPs within the estimated budget. On another hand, usually IPs cannot expect to get higher financing than planned assignations and, therefore, can be actually finished without full completion. This aspect of IPs is poorly analyzed and requires more detailed analysis in the following researches.

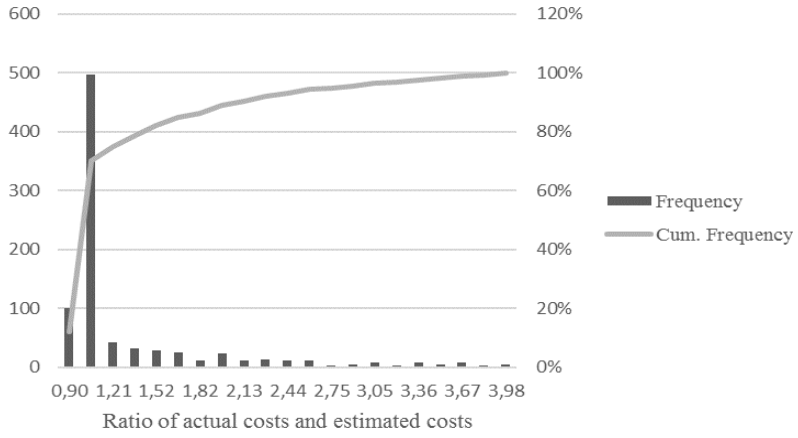


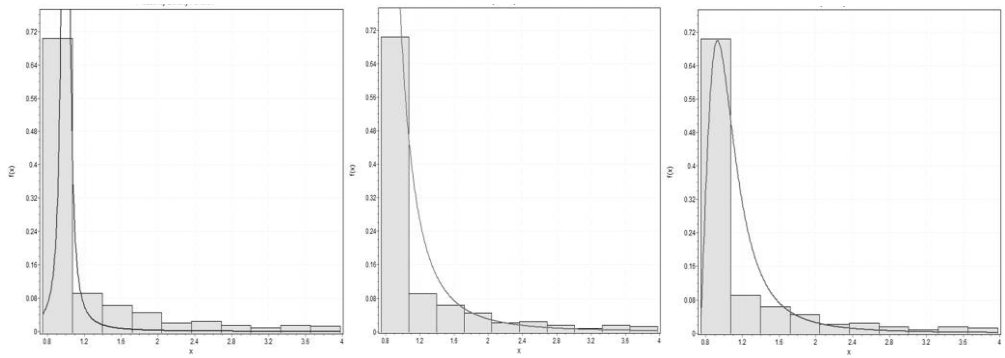
Figure 2.2. Distribution of ratios of actual and estimated costs (prepared by the author of this dissertation)

The remaining 1/3 of IPs are characterized by an excess of estimated budget. The descriptive statistics revealed that the excess was not greater than 1/5 (21,05%) in 3/4 of the cases; however, the values between IPs were widely distributed. Within one standard deviation, the values were distributed in the range of $R \in (0{,}6389–1{,}8733)$, whereas the asymmetry is positive. Considering these statistics, it is assumed that it is more likely that the estimated investment costs will be exceeded than that the IPs will be implemented within the limits of the estimated budget. The results in different groups of IPs are analyzed in the article prepared by Jasiukevicius & Vasiliauskaite (2015a).

The results of analysis based on Kolmogorov–Smirnov test revealed a list of statistically the best PDs which enable to define Risk in public IPs. Appendix 8 presents the top 5 PDs in each group as well as in a general sample, with Loglogistic (3 parameters), Gen. Pareto and Cauchy PDs have been the most often listed, respectively, 6, 4 and 4 times. Cauchy was distinguished as “the most suitable” in 4/6 of the groups, while Loglogistic was the only one listed at the top of every group. Considering the fact that the estimated distances between these theoretical and the empirical samples in each of these PDs are very similar, the PDs have been matched only statistically and their significance of congruence is identical, in order to choose the most appropriate one, the peculiarities of all PDs have to be considered, since the parameters of theoretical PDs are such that total distances between PDs and samples would be the smallest. However, the theoretical PDs formed in such a way can be very receded from the samples in their separate parts.

This shows the requirement to complement quantitative risk assessment techniques by qualitative evaluation under these circumstances.

Cauchy is a symmetrical PD which, in comparison with normal PD, is characterized by a very high excess, i.e. a high concentration of values around the mode (Figure 2.3). This feature in a great part of its range could reflect the observed tendency of a considerable part of the projects to be implemented within all estimated budget. However, due to the same feature, the REs calculated by this PD are very small, i.e. in 70% of the cases, the excess of the most expected value did not exceed 0.1–4.4% depending on the group, which is too low for a recommended minimum 10% level (Eliasson & Fosgerau, 2013). Therefore, Cauchy was not the best option in this case. The application of Gen. Pareto, whose mode consists of the lowest value in the sample also was not the solution, since the assumption that the most expected value of estimated investment costs equals the lowest possible value is unacceptable.



Cauchy Gen. Pareto Loglogistic (3P)

Figure 2.3. Graphs of probability density functions (Jasiukevicius & Vasiliauskaite, 2015a)

Loglogistic consistently reflected the empirical samples in most of its range: 1) high excess and concentration of values around 1 reflect the fact of a great part of public IPs is to be implemented within the estimated budget; 2) the positive skew illustrated the observed tendency of the public IPs to be overrun in respect of the estimated investment budget in the general case, and; 3) the PD also reflects a small possibility of public IPs to be implemented with lower costs than it was estimated. Moreover, high ranks in the lists disclose its universality to be applied for risk assessment in different long-term asset classes. These features determine Loglogistic as the most suitable PD to assess Risk in public IPs.

Considering the literature where such PDs as normal, triangular and lognormal are mostly mentioned in the context of risk assessment in the IPs, the results of research were unexpected. However, the observed PDs of real values have been moved far away from these theoretical PDs, ranking them only in the places of thirty-fifth and lower (Appendix 8), disclosing the high potential of Loglogistic. The use of this PD would allow expecting to get the most accurate results of evaluation

of Risk in IPs, especially in the case of Lithuania. Table 2.2. presents the estimated parameters which allow assessing Risk in all seven groups.

Table 2.2. The parameters of Loglogistic enabling to assess Risk in IPs (Jasiukevicius & Vasiliauskaite, 2015a)

Group	Title	Parameters
A1	Land	α = 2,1121; β = 0,30732; γ = 0,74111; Mode = 0,9299
A2	Real estate	α =2,1121; β = 0,30732; γ = 0,74111; Mode = 0,9299
A3	Construction, major and other repairs	α =1,9673; β = 0,32927; γ = 0,74202; Mode= 0,92827
A4	Equipment and machineries and other assets	α =2,7906; β = 0,28554; γ = 0,72694; Mode = 0,945188
A5*	Projection, technical maintenance and other services related with investment into A1-A4,	α = 1,8405; β = 0,25464; γ = 0,75111; Mode = 0,88251
A6	Reinvestments (into A3 and A4)	α =2,1274; β = 0,30981; γ = 0,73931; Mode = 0,931093
A7	Other services	α = 1,9247; β = 0,23155; γ = 0,7493; Mode = 0,876598

In summary, the satisfaction of preparatory conditions for a reliable assessment of PPP's possibilities to optimize investments in public infrastructure primarily requires preparing an IP which represents the public scenario, which includes many steps to be coherently accomplished to determine the best option for IP implementation and calculate its costs. The assessment of financial aspects plays one of the most significant roles in this process; however, it is also one of the most discussed. Determination of FDR and assessment of risks are in the center of these discussions; however, as the analysis of literature disclosed, they are not particularly productive in outputs which could provide practical solutions. Considering this issue, the appropriate practical solutions are provided.

2.1.2. Expediency criteria for the analysis of PPP's possibilities to optimize investments in infrastructure

Since the transaction costs of PPP's procurement can be significant in respect of the total investment costs, it is important to find criteria which would allow selecting those IPs which could be characterized as having PPP potential and, therefore, would be justified for additional funds spent on their full analysis and preparation.

Considering the conception and features of PPP, analyzed in Section 1.2.1., its advantages and disadvantages, described in Section 1.2.3., and the factors motivating the public sector to go into a PPP with the private sector, mentioned in Section 1.1.2.1., the following criteria can be distinguished to assess the expediency of an IP to be fully analyzed for its implementation as PPP:

Requirement to invest in infrastructure. Since the shortage of public funds to finance the infrastructural IP is one of the important arguments to look for alternative ways of IP implementation and service delivery, primarily the question of whether the IP requires enough large new capital investments is relevant and, if yes,

how many. The threshold for investments cannot be determined, since this can be affected by many different aspects. However, this amount by default has to be large enough that it would provide a fiscal challenge for governments to implement the IP under CP. In other words, the decision for expediency of full analysis of PPP mostly depends on the financial possibilities of the PPA which, in case of budget restrictions, are constrained to take interest in alternative financial arrangements to cover capital investments.

A long-term demand of infrastructure and services. When a private entity comes into a PPP by investing an appropriate amount of investments, enough time is necessary to recover them, which determines the length of cooperation period with the private entity and requires appropriate demand of infrastructure and services to be ensured so that these investments would be justified regarding fundamental public interest. Since, considering the above-mentioned criterion, capital investments in PPPs are usually relatively large, there is a logical solution to try making the cooperation period long enough to make the PPP financially affordable in respect of funding from the public budget or/and the price for the end-users. Therefore, there has to be clear indication that a sufficient level of demand for infrastructure and services can be forecast and will be ensured for an appropriate period of time, which can continue until the end of useful lifetime of assets and until the private subject recovers its capital investments.

Complexity of transferred services. The PPP can be the most beneficial in respect of efficiency and quality when it integrates various interrelated tasks from projection and construction to operation and maintenance, which may result in the optimization of whole life-cycle costs of IP implementation and service delivery. Therefore, it is important whether there are any indications that the PPP can provide additional benefits, e.g. cost savings, higher quality, less chances for delays, etc. from the complex transfer of service delivery to the private entity.

Possibility to measure output of services. To encourage efficiency and innovation from the private entity, it is important to focus on the outputs rather than inputs regarding the requirements of infrastructure and service delivery. The output specification sets out the range of services the government is seeking to procure and the performance levels required for each of those services. Therefore, it is important whether the results of infrastructure and service delivery can be measured in clear output specifications and key performance indicators. This can be challenging, if the public sector does not have any determined standards of services considered to be transferred to the private entity to deliver, which creates an issue when defining what the private entity should do and what can be later considered as good results of its performance. Therefore, the possibility to specify output specifications is crucial for the selection of the best bid and successful monitoring of the private entity's performance (Liu et al., 2015; Felix Villalba-Romero & Liyanage, 2016).

Possibility to share or allocate risks. Since the possibility to transfer at least a part of risks is one of the main arguments in favor of PPP, it is important to know, whether there are no significant restrictions on sharing or transferring risks to the private entity, which could result in a loss of possibility to allocate risks between the parties, depending on which of them can manage them at the least costs. These

restrictions are usually related to legal requirements, which can allow the appropriate services to be provided solely by the public sector, e.g. convoying prisoners, maintenance of facilities containing top-secret information, etc. The indications of reluctance from the market of the private sector to bear the appropriate risks, such as the construction and availability, would also be considered as a barrier for further establishment of PPP.

Possibility clearly to identify revenue streams. Since the private entity comes into PPPs for profit, revenue streams for the delivery of infrastructure and services to the private partner have to be clearly identified. Revenues can come from the government, direct users or a combination of both. In any case, there should be clear indication that the financial sustainability of the IP will be ensured.

Interest of the private sector. The PPP is worth to be considered, if there are clear indications of the private sector being interested in the IP. It is relevant to assess whether there are the private entities which would be able to ensure sufficient technical, operational, financial capabilities to implement the IP. This usually requires market research and a good communication plan.

All these criteria based on a qualitative analysis and mostly scored only qualitatively ('yes' or 'no') are equally important for making a decision of whether it is worth to spend additional funds for fully analyzing the possibilities of PPP to invest in public infrastructure. Since they cover the main assumptions for successful PPP structuring, they all require positive assessment. A particular exception could be the criterion related to the requirement to invest in infrastructure, since there are some forms of PPP, under which the private entity is not required to invest in infrastructure. On the other hand, these forms are not everywhere considered as PPP[42].

Since the main criteria allowing the PPA to select the IP emphasizing by PPP potential are identified, the methodological aspects of designing of IP rational to compare against the private bids are further analyzed in the following section.

2.1.3. Designing the Public Sector Comparator

As mentioned in Section 1.3.1., a reliable assessment of possibilities of PPP to optimize investments in public infrastructure primarily requires developing the PSC model which would be rational to compare against the shadow or actual private bids, where VfM could be assessed and rational decision for the best way of IP implementation could be made. Considering the discussed aspects of VfM assessment, this section is devoted to analyzing the methodological aspects of designing a proper PSC cost model which would enable to make the above-mentioned decisions.

The PSC, considered as an alternative to the public sector, conceptually requires including an overall picture of the IP's cost, if it were to be implemented under the CP. As a tool used by governments to determine the proper provider of infrastructure and services for the public IP, it is rational, if the results of initial IP, whose stages of preparation have been analyzed in Section 2.1.1., allow conforming

[42] See Section 1.2.2.

its technical and environmental feasibility and demonstrating socio-economic benefits. When these conditions are satisfied, the option with the highest socio-economic benefit is rational to further analyze for the purpose of finding the most efficient way of implementation. Accordingly, the PSC allows the PPA to figure out whether the PPP would be more cost-effective than the most efficient option of CP. To get reasonable results of comparison, it is important to structure the appropriate public sector's alternative so that it is rational to compare against any other option from the private sector. Accordingly, this process requires the following steps:

Definition of the scope of PPP IP and formulation of output specification. To rationally assess the possibilities of PPP to optimize investments in public infrastructure it is important to define the appropriate scope of the IP in respect of the number and scope of tasks to be transferred to the private entity, which would be considered as the procurement object of the PPP. Literature is very poor regarding this aspect, but the existence of various forms of PPP where the most suitable one has to be chosen implies this process as being iterative in nature. At the end of this analysis, the results of PPP can be completely different from the scope of the initial IP.

The following aspects should be considered to define the scope of PPP, for which the PSC is prepared. First, a set of particular transferring tasks to the private entity can be lower in comparison with the scope of the initial IPs and depend on the legal framework regulating the possibilities to transfer particular tasks to the appropriate public sectors to the private one, abilities to achieve VfM in the scope of transferring tasks and possibilities to keep the delivery of infrastructure and service financially sustainable throughout the whole life-cycle of the IP, in respect of financial affordability from the PPA or/and prices to the customers. Second, in order to clearly allocate risks between the partners, tasks are usually transferred to the private entities at a full scope including those CFs, which, since they have been prepared on incremental basis, have not been included in the initial IP. Therefore, the scope of the PPP in monetary terms can be larger in comparison with the scope of the initial IP. Third, to make the IP attractive to the private sector, the PPP may include the CFs exceptionally related to commercial activities of the private entity and which, therefore, have not been included in the scope of the initial IP, which has been prepared purely from the perspective of the public sector. These activities also expand the scope of the IP in the PPPs.

Table 2.3 provides a general example of differences between the scopes of IP and PSC/PPP in a case of building new infrastructure for delivering services. It shows that under the traditional approach the government has to perform all tasks throughout the whole project life-cycle. In the case of PPP, the government remains with the provision of main and complementary services, since it is a function of the municipality. While, all other tasks related to the development, operation and maintenance of infrastructure are transferred to the private sector. Moreover, it can also perform additional commercial activities in the developed infrastructure outside of the main education hours, if this allows decreasing the public sector's payments for the availability of infrastructure to the private entity. Depending on the

distribution of tasks among the entities, risks are allocated accordingly as it is explained later in this section.

When the scope of PPP is defined, a particular output specification can be formulated, by following which the government can develop the procurement conditions defining the performance level in respect of the scope and quality for each of the transferred services.

Table 2.3. Example of possible differences among the scopes of IP and PSC/PPP (prepared by the author of this dissertation)

Task	IP	PSC/PPP
Development of Assets		
Design	+	+
Construction	+	+
Equipment	+	+
Main service delivery		
Main services	+	-
Complementary services	+	-
Other service delivery		
Secondary services	+	+
O&M		
Operation of infrastructure	+	+
Maintenance and repair	+	+
Additional activities		
Commercial activities	-	+

Identification of Raw PSC components and assignation of costs. The Raw PSC can encompass various components from direct costs that can be traced or assigned to particular services (direct capital costs, capital receipts, direct maintenance costs, direct operating costs, etc.) to indirect costs, the occurrence of which is not directly related to the delivery of services (partial usage of administrative buildings, partial commitment of plant and equipment, corporate and administrative overhead, etc.). If the scopes of the initial IP and PPP are identical, most CFs can be taken from the initial IP. Otherwise, CFs allowing to represent a full scope of transferred tasks have to be added. In other words, since the PSC has to present full costs of infrastructure and service delivery, the incremental approach has to be refused and full CFs are used instead. Moreover, in order to avoid any distortion in the results, any CFs related to the third parties' revenue have to be excluded from the calculation. Accordingly, the Raw PSC can be calculated by modifying Formula 7[43], where full CFs are used instead and the residual value is usually equated to zero if a part of the newly developed asset is not left to the private entity (Formula 8).

$$PSC_{RAW} = \sum_{t=0}^{t=n} \frac{I_t - RV_n - RE_t + OM_t + FAC_t + PC_t + POC_t}{(1+r)^t} \quad (8)$$

[43] See the section 2.1.1.

Assessment of competitive neutrality. Competitive neutrality is an important part of PSC, since it allows removing the net competitive advantages that accrue to government business due to the virtue of its public sector ownership. This allows like-with-like VfM assessment between the PSC and the private bids, by removing the effects of public ownership and including equivalent costs that would otherwise be incurred. These costs are related to different taxation of the public and private entities regarding land, property, payroll, local government and capital transaction taxes. However, as discussed in Section 1.3.1., the differences between different levels of government representatives, such as national, regional, business unit have to be also considered when assessing competitive neutrality since the costs spent by an institution to pay the appropriate taxes can be treated differently, depending on which part of them are regained as budget income. Accordingly, the results of PSC as well as VfM assessment can be different depending on the perspective from which the assessment is done. Therefore, for better understanding of VfM results, the PSC at different levels for governing has to be calculated.

Calculation of risk values. All material-retained risks should be included and evaluated to provide a comprehensive measure of the full cost to the government under the PSC. The evaluation of risks conceptually requires three elements: 1) identification of all material risks; 2) quantification of risks impact (loss), and; 3) estimation of their occurrence. Their interdependence is shown in Formula 9.

$$Risk = \sum_{i} L_i \, p(L_i) \tag{9}$$

here: R – total risk value, i – individual risk event, L – loss, $p(L)$ – probability of loss occurrence.

The formula shows that the value of risks is a sum of individual risks which are the result of estimated loss and probability of loss occurrence. Therefore, the objectivity of evaluation directly depends on how clearly the assumptions of potential loss and probability of occurrence can be presented. This can be very difficult to measure, since the chance of error in measuring both concepts is usually high.

The traditional approach to risk assessment suggests to start this process by identifying relevant RFs (Lehtiranta, 2014). Then, potential loss is determined and probabilities of their occurrence are estimated, and the result of multiplication is a value of risks, accordingly. However, when this technique is used, the reliability of results, besides the aspects discussed in Section 2.1.1., highly depends on whether RFs are independent from each other, i.e. the occurrence of one RF can affect the occurrence of another which, unfortunately, is difficult to avoid in most cases. For example, a potential error made in the technical project, which can be considered as a design risk, can heighten the total costs of construction, operation and maintenance, which, in turn, can be considered as construction risk and availability risk, respectively. The longer list of RFs is included in the quantitative assessment, the more difficult it is to avoid the error of double counting, which may cause the

overestimation of IP's risk. It is complicated to determine REs, since they are difficult to link to appropriate CFs which require expert-based evaluation and, therefore, determine the high subjectivity of the results. Moreover, starting the risk assessment from the identification of RFs and subsequent calculation of their values causes another issue of proper arrangement of REs over the whole life-cycle period of an IP, since financial consequences of risks can appear much later in the comparison with the occurrence of actual reasons which could explain them. For example, loss caused by the same error of design can be actually experienced in the later phases of IP implementation, such as construction or operation. As a result, since this approach is used with the appropriate technique, reliable risk assessment is a significant issue in practice.

Considering the research results of cost overrun risks in a public IP, presented in Section 2.1.1, the author of this dissertation suggests solving the above-mentioned issues by adopting an inverse approach to risk assessment, the main principles of which can be explained as follows. To assess an IP's value of risks, firstly, PDs reflecting the tendencies of possible CF changes from the estimated values should be applied to all direct CFs resulting in calculated REs for each of them. Secondly, each direct CF with their REs has to be attributed to one of the appropriate risk groups (RGs), where they also have to be summarized. Finally, the values of RGs have to be equally divided into relevant RFs identified in the appropriate RGs regarding IP implementation.

This quantitative approach to risk assessment is reliable as long as suitable PDs are applied and their parameters accurate to reflect potential risks, since it primarily focuses on the calculation of risk values of the specific CFs and only later these values are allocated among various individual RFs. This requires collecting data from actual experiences of IP implementation, so that the general tendencies could be envisaged and shaped into appropriate PDs. Since only the data related to IP implementation could be found, the author of this dissertation could provide only PDs suitable to assess the Risk[44]. However, if the statistics of estimated and actual CFs were available, a similar methodology, described in the paper of Jasiukevicius & Vasiliauskaite (2015), could be also applied to calculate REs for CFs of revenues, and O&M costs. Since the data related to these CFs is unavailable, considering the results of literature analysis performed in Section 2.1.1., besides the PD provided in the Table 2.4, it is suggested to use the following PDs to measure risk asserted in the appropriate CFs.

Table 2.4. PDs applied to CFs of IP (prepared considering Tecolote Research, (2007))

CF	PD
Investment cost	Table 4
Revenue	Normal
O&M costs	Triangular, PERT
Financing	Normal
Residual value	Normal

[44] See the Table 2.2.

The suggested approach calculates risk values on CFs at the time when they are planned to be experienced that, in this sense, makes it less subjective, since it is assumed that all risks can be managed in time but at different costs.

Regarding the allocation of REs into the RGs, the author of this dissertation, considering the nature of the main CFs in a public IP, has distinguished eight RGs, among which REs of CFs can be allocated. Table 2.5 shows the links between RGs and the appropriate CFs. Design RG materializes in the overruns of costs related to the preparation works of IP implementation, such as feasibility studies, design project, etc. The financial value of construction RG consists of cost overruns in construction works. The requirement to invest more than it was estimated in the quality of acquiring equipment, machinery and services can be shown in the increase of investment costs of equipment and service, accordingly. Fluctuations of interest rates can be expressed in the value of financing RG. The availability RG is directly related to O&M expenditures, since deviations from the plan require additional operating costs to keep the infrastructure available to use according to the foreseen scope and standards. Lower than expected revenues can usually explain the value of demand RG. Finally, residual value RG is the result of deviation in the actual residual value from the estimated value and the requirement to reinvest more than expected to keep residual value at the predetermined level.

Table 2.5. Assignation of CFs to the RGs (prepared by the author of this dissertation)

No	RG	CF
1.	Design	Design costs, research, studies.
2.	Construction	Investments into land, real estate, construction works.
3.	Equipment quality	Investments into equipment, machinery, information technologies (IT), furniture, etc.
4.	Service quality	Investments into services
5.	Economic (or financing)	Interests
6.	Availability (or operation)	O&M expenditures
7.	Market (or demand)	Revenue
8.	Residual value risk	Residual value, reinvestments

When the values of RGs are known, each of them can be divided into relevant RF (Figure. 2.4.). Since the values of all RFs in the RG are the same, the higher number of individual RFs the RG is, the lower value of every individual RF is. On the one hand, this assumption is rather subjective, since every risk can have a different financial outcome; however, it allows avoiding risk of double counting the IP's risk values, which is very important in order to determine the full cost of public scenario and further consider the transfer of a part of risks to the private sector.

The risk value distributed among RFs can be further allocated/shared between the public and private entities, since this is the essence of PPP. Literature analysis (Ernest Effah; Ameyaw & Chan, 2015; Chou et al., 2012; Chung et al., 2010; Hwang et al., 2013; Ke et al., 2010; Martins et al., 2011; Ng & Loosemore, 2007; Li

Yin Shen et al., 2006) has allowed identifying a list of RFs which are encountered in the context of PPP IPs (Appendix 9). It is non-finite and can be expanded or narrowed depending on a particular case. The analysis disclosed that the PPP IP, beside the RFs inherent in the IPs, may have some additional risks which are specific to the PPPs (Appendix 10). Mostly, they are a part of legal risks and are related to specific asset ownership, equity investors issues or lack of national PPP law to regulate the relationship among the private and public entities in the PPPs. Although according to the descriptions of RFs, they may look as inherent to PPPs, they are not significantly distinguished from the CP, e.g. disputes among the private entities and PPA, issues of financing, cost management, demand, economic phenomenon, etc. are inherent in both CP and PPP cases. This conclusion is important, since PPP as the way of delivering infrastructure and services is developed to share risks between the parties rather than create new ones.

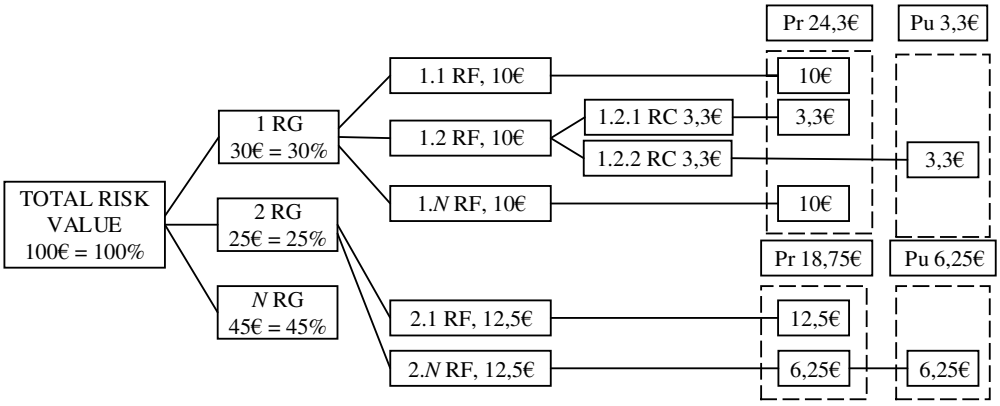


Figure 2.4. Risk value allocation scheme (prepared by the author of this dissertation)

To develop recommendations for risk sharing/allocation, RFs allocation preferences were analyzed with regards to different literature (Appendix 10). Although not all identified RFs have been mentioned by the scientists regarding their allocation between the partners, the results appear to be rather unequal regarding scientists' preferences. Five out of 65 RFs have been found to be allocated to the public sector, which are as follows: "government's intervention", "expropriation and nationalization", "government reliability" and "land use". The results also allow indicating 15 RFs which should be mostly allocated to the private sector. These include: "financing", "construction completion", "construction cost overrun", "operation cost overrun", "maintenance cost overrun", "insufficient income", "fluctuation of material costs", "operator default", "insolvency of operator", "quality risk", "availability of labor/materials", "labor disputes and strikes", "waste of materials", "protection of geological and historical objects" and "low operating productivity". In between "force majeure" risk was identified as preferably shared between the public and private sectors. While other RFs, beside those which have not been allocated or allocated just once and showed no tendency, had different preferences regarding their allocation among the public and private

entities. However, these results have to be evaluated with caution, since the analysis was based on names of RFs and not on their descriptions, which could affect the results. For further analysis, each of the RFs has to be divided into risk cases (RCs) which describe the responsibilities of each partner in the defined scenarios. This is partly demonstrated by providing the perspective of the author of this dissertation towards the preferences of risk allocation (Appendix 10). A deeper analysis requires wider legal studies which is not in the scope of this dissertation. A summarized solution is provided below instead.

Allocation of RFs is easier to explain when they are attributed to the appropriate RGs. Literature analysis (Guasch, 2004; Hwang et al., 2013; Ke et al., 2010; Martins et al., 2011; Ng & Loosemore, 2007; Li Yin Shen et al., 2006; Xu et al., 2012) allowed classifying RFs into the following RGs:

1. Legal RG – includes RFs related to procurement and contracting;
2. Political RG – includes RFs related to political decisions and government actions;
3. Force majeure RG – includes RFs which are extraordinary events or circumstances beyond the control of the parties such as riot, crimes, war, strike or other event described by the legal term of "act of God" (hurricane, flood, earthquake, etc.)
4. Market RG – includes RFs related to the changes of demand;
5. Operation RG – includes RFs related to the availability of infrastructure;
6. Design RG – includes RFs related to errors and inefficiencies in design of infrastructure;
7. Construction RG – includes RFs related to investment cost overrun and delays in completion. It is comprised of construction, equipment and services risks presented in Table 2.4;
8. Economic RG – includes RFs related to changes in the financial market;
9. Residual value RG – includes RFs related to issues due to which assets may not be normally running at the end of PPP.

Figure 2.5 presents the relationships between the above-mentioned RGs. It shows that, in general, risk can be divided into two major groups: related to commercial risks and non-commercial risks. The former includes legal, political and force majeure RGs, for which, since they do not depend on direct actions of IP promoters, REs are not calculated and, therefore, they are not included in the PSC model and foreseen only in the PPP contract. Since political risks are related to the government and its actions, it is preferable to leave this RG to the public sector. Legal risks in the scope of government or PPA officers and their actions are usually assumed by the public sector. However, legal consequences associated with the failure of the private entity to perform its responsibilities have to be transferred to the private entity. The management of force majeure risks, since they are above the abilities of both parties, is preferably shared among the parties; there is also a tendency to allocate the higher share of this risk to the public sector, since, the

public sector is the only party able to bear such risk, given its size and difficulty of obtaining adequate insurance (EPEC, 2013; World Bank, 2016).

The latter major group is comprised of risks directly related to IP implementation and service delivery and, therefore, are assessed quantitively by estimating REs and included in the full costs of the PSC model. It is comprised of market, availability, design, construction, financing and residual risks which, to encourage whole life-cycle cost efficiency of IP, are preferable to be mostly transferred to the private entities. The exemptions are market risks, which can be partially or fully assumed by the public sector, depending on how many guarantees are provided by the government, which determines whether the socially-based or economic-based PPP is chosen. The archaeological risk, although it is a part of the construction RGs, is also preferably allocated to the public sector, since the site of construction is usually chosen by the PPA.

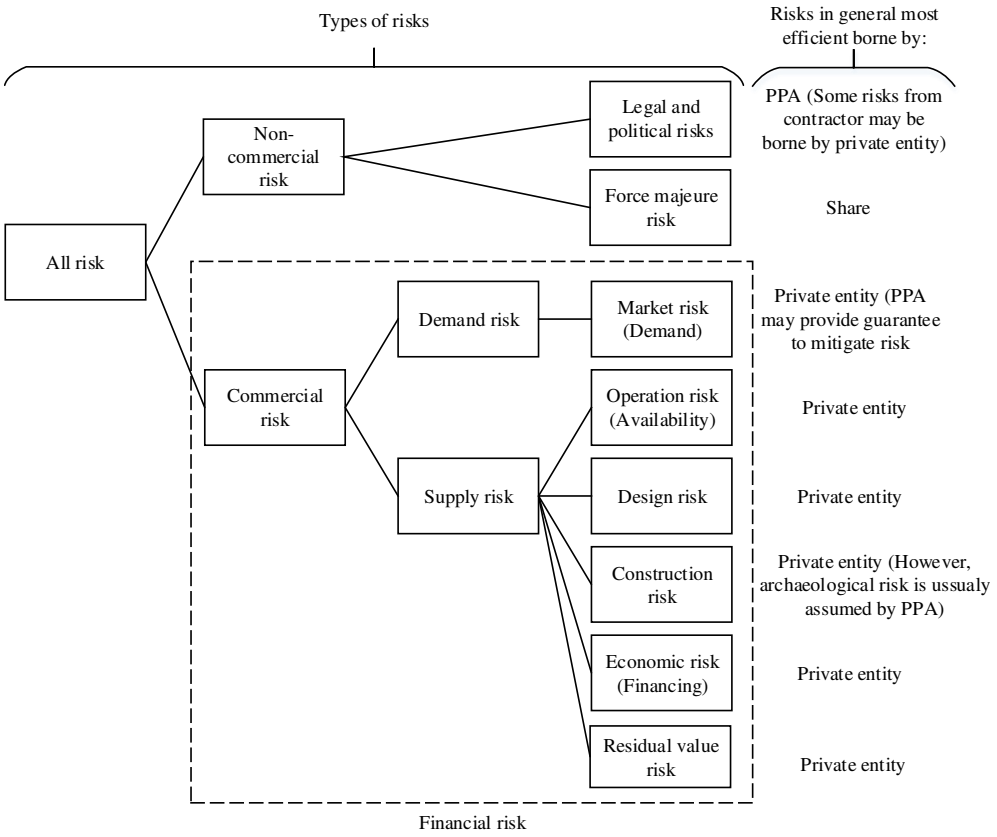


Figure 2.5. Relations between RGs and preferences regarding their allocation (prepared by the author of this dissertation)

The reason for evaluating retained risk for constructing the PSC, which includes both retained and transferred risks, is that, to minimize the full costs of IP implementation, special consideration should be given to the abilities of government to mitigate risks in practice. Since, risk mitigation is considered to be minimization

and controlling of either or both the consequences and the probability of risk, risk retained by the government can be considered to be transferred to the third-party in the form of commercial insurance (Commonwealth of Australia, 2008). In this case, the cost of the insured risk to PPA is no longer included as retained risk, since it has been passed on at a cost to a third party. Instead, the cost of premiums should be included in the Raw PSC. However, usually not all risks are likely to be commercially insurable in the market. Therefore, a particular part of risks always remains with the PPA. Figure 2.6 illustrates the relevance of insurance in the evaluation of retained risk.

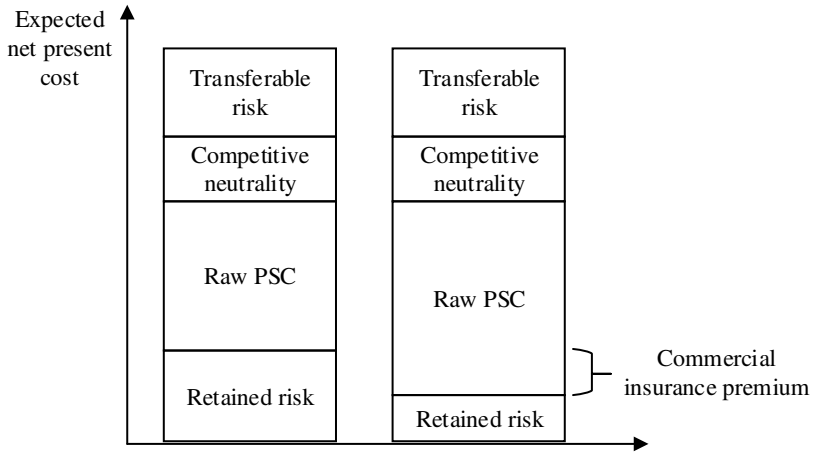


Figure 2.6. The structure of PSC and the effect of commercial insurance (prepared according to Commonwealth of Australia (2008a).)

Figure 2.6 allows summarizing the above-mentioned steps required to construct an appropriate public sector's alternative which is rational to compare against any other option from the private sector, so that the PSC can be considered as the Raw PSC adjusted by competitive neutrality costs and the sum of transferred and retained risks (Formula 10). This can be considered as the NPV of Maximum Financial Obligations of the Public Sector ($FOPS_{max}$) in the PPP, above which the PPP does not provide financial benefits in respect of cost-efficiency.

$$FOPS_{max} = PSC = PSC_{RAW} + \sum_{t=0}^{t=n} \frac{CN_t + Risk_{rtn_t} + Risk_{trf_t}}{(1+r)^t} \quad (10)$$

here: PSC_{RAW} – Raw PSC costs, CN – competitive neutrality costs, $Risk_{rtn}$ – retained risk, $Risk_{trf}$ – transferred risk.

Considering the allocation of RFs, other derivate indicators can be calculated:

- *Maximum Financial Retained Obligation of the Public Sector ($FOPS_{rtn}$) in the PPP* (Formula 11). Since the scope of PPP includes only those tasks which are transferred to the private sector, the indicator assesses only the risk which remains with the public sector in

the PPP. These obligations are later added to the Shadow Bid (SB) model.

- *Maximum Payment for the Private Sector (MP_{pr}) in the PPP* (Formula 12) allows determining the maximum payments to the private sectors for transferred tasks including the associated risks, above which the PPP becomes financially irrational. In this case, the implementation of PPP IP, where payments are higher than this value could be justified only for reasons of financial affordability and NFBs, discussed in Section 1.3.1. and detailed in Section 2.1.5.

$$FOPS_{rtn} = \sum_{t=0}^{t=n} \frac{Risk_{rtn_t}}{(1+r)^t} \tag{11}$$

$$MP_{pr} = PSC_{RAW} + \sum_{t=0}^{t=n} \frac{CN_t + Risk_{trf_t}}{(1+r)^t} = FOPS_{max} - \sum_{t=0}^{t=n} \frac{Risk_{rtn_t}}{(1+r)^t} \tag{12}$$

Beside obligations of the PPA in the PPP, it has to be considered that the PPA may also have other obligations, generally related to the outputs of infrastructure and services delivered in the PPP, but outside the scope of PPP procurement. These obligations are equally important for the successful implementation of the IP and service delivery. Therefore, the financial affordability of the PPA to assume full obligations within and out of the scope of PPP procurement should be assessed to ensure financial viability of the IP. This is especially important in the case of institutional PPP, where the public sector, transferring all or most tasks to the private entities, also participates in the formation of capital structure and assumes financial risk proportionally by a share of owned assets. The shares are usually paid for by providing the existing public assets.

There is the PPA's position on how much PSC information should be disclosed in the Request for Proposal (RFP). To get rational proposals in respect of apple-to-apple comparison, financial affordability, etc. the PSC (either in periodic cash flow or NPC form) should be disclosed to market unless there are justifiable reasons for non-disclosure. As a part of this, other key financial and operating assumptions, such as Raw PSC also could be disclosed. However, this should be weighed against the expected benefits available to get from the market. The reason of limited disclosure of more detailed information can be low competition in the market due to which, if the public scenario would be known, it would be difficult to expect benefits in respect of higher efficiency and innovation from the private participation in the provision of public infrastructure and services. Therefore, the amount of disclosed information should be proportional to the expectation of the public sector with regards to the potential of the private sector to transform it into more efficient and innovative proposals. Market research could help to collect the necessary information.

The methodological aspects of PSC structuring analyzed in this section allow arguing that the inclusion of both raw cost and cost associated to risk promotes the

understanding of full life-cycle costs of the IP at an early stage of its development and creates confidence in the rigor of the further evaluation process to decide whether the PPP would provide better value than CP. Although some of its elements, such the determination of FDR, assessment and allocation of risk have some flexibility in respect of how they can be determined, the suggested systemized solutions also provide possibilities for a standardization of this process, which creates more possibilities to increase transparency of the assessment process and the obtained results.

2.1.4. Designing the PPP model

Beside the PSC, the assessment of PPP's possibilities to optimize investments in public infrastructure conceptually requires estimating the whole life-cycle costs of the PPP options, either as proposed by the private bidder or as the hypothetical SB at the pre-procurement stage, which attempts to predict the bidder's costs, financing structure and other assumptions. This is also indistinguishable from the assessment of whether the PPP is affordable to the government. Since this dissertation is focused on the pre-procurement stage, i.e. the issues related to the initial financial assessment and feasibility study of an IP to determine the most appropriate procurement method, this section is mostly devoted to structuring the SB model rationally to compare against the PSC.

Within the context of public investment, SB is described as the estimated cost to the public sector, if the same IP, for which PSC has been calculated, would be delivered by the private sector as PPP. It represents the expected bid price that the PPA may receive from the market for transferring some predetermined combination of tasks such as design, construction, financing, operations and maintenance, including the collection of revenues, if it is foreseen to do so, from the direct users. To make it rational for comparison, the scope of SB must be identical to the PSC. Therefore, since the process of determining the scope of PPP is iterative in nature, the changes in the assumptions regarding the scope of PSC require appropriate adjustments of the SB to ensure consistency among both procurement options.

Since the scope of PSC/PPP and the main cost and revenue elements are known[45], it is important to choose the type and identify the appropriate form of PPP to construct a rational SB. The PPP, as an alternative way of implementing IP and delivering service, includes a wide spectrum of forms and schemes, analyzed in Section 1.2.2; however, literature regarding the issue of how to select the most suitable form is weak. The analysis of all possible forms, due to limited resources, is not rational, therefore, it is important to narrow the circle of potential to analyze forms of cooperation as early as possible.

When selecting forms of PPP, the line is usually drawn between PPPs developed on a contractual basis and those developed on an institutional basis. The potential solution is provided by Batran, Essig, & Schaefer (2004) and Dūda (2010), who suggested selecting the type of PPP depending on the strategic importance and specificity of services foreseen to provide in the PPP. According to the above-

[45] See Section 2.1.3.

mentioned scientists, specificity is one of the most important factors for deciding whether tasks of public infrastructure and services' delivery should be included in the internal process of public organization or transferred to the external party, i.e. whether the PPP should be implemented on an institutional or contractual basis. Specificity can be described as exceptional abilities, processes and particular use and management of resources which have such unique value that it is refused to use alternative options. Specificity causes the collaborative parties to operate in an ex-post bilateral dependency after the completion of construction. While the strategic importance in the selection of PPP type is determined by the PPA's political goals and strategy. These political goals determine the appropriate operating methods and resources which have to be used, define which functions and tasks of the public sector are important in respect to the strategy and, therefore, cannot be transferred to the external providers of the private sector. Strategic importance is related to the core competencies of the public sector. Hence, strategically important tasks are highly integrated within the public administration or public companies.

Figure 2.7 shows that if the specificity is as low as core competencies are not contemplated while the strategic importance is high, the PPAs have to set up JV PPP as a distinct legal entity (SPV) established from both public and private materials and intangible assets. Conversely, if the specificity of public goods and services is high while their strategic importance is low, then it is more expedient to establish the PPP on contractual basis. In other words, the PPP on a contractual basis stands unavoidably for pure market contracting and for non-specific goods and services where discrete contracting is sufficient to ensure the public interest.

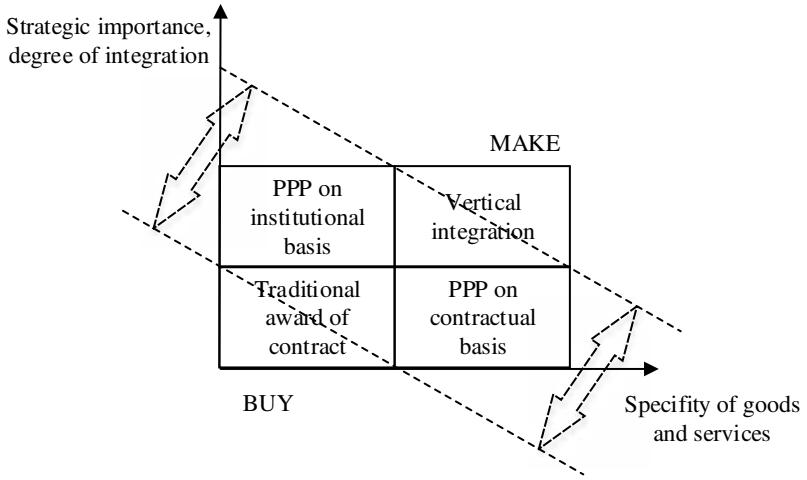


Figure 2.7. The field of PPP application and choice of PPP type (according to Batran et al., (2004))

Considering the above-presented model, the PPA has to choose one of the alternative types of PPP, depending on how important it is to not only have impact on the outputs, but also influence the process. The more important it is, the more it is relevant for the PPA to establish a JV and participate by equity. The larger is share of equity owned by the public sector, the larger part of risk it assumes. However,

with higher share of equity means stronger power to influence the activity of the JV. Therefore, there are more possibilities to ensure public interest in the PPP. All these aspects determine the attractiveness of PPP established on an institutional basis. However, if public interest can be ensured by controlling only the final outputs of PPP, then it is more rational to choose PPP established on a contractual basis. This type of PPP, in comparison with the institutional PPP, is less formalized, gives more freedom to the private entity for innovation and enables the public sector to transfer a significant part of risk to the private sector. However, due to lower possibilities to control the process of IP execution, the PPA has lower possibilities to protect public interest related to the implementation of the IP, if something goes wrong or/and changes are required.

When the type of PPP most suitable to represent public interest is selected, the form of PPP has to be identified. In the scope of both types, there are many forms, which have been analyzed and compared in Section 1.2.2. In the case of institutional PPP, basically one form is possible – a JV, which can be established for a temporary period or be unlimited in respect of time. The former is established to implement IPs of specified duration, while the latter, the so-called strategic partnership, is emphasized by continuity as long as needed to achieve the strategic purposes (Dūda, 2010; D. Hall, 2008).

The choice of contract-based forms is wider and they significantly differ, as shown in Appendix 3, depending on transferring tasks to the private sector, what mainly determines which forms would be the most suitable for each of the cases. However, according to Hemming (2006), Thillai, Siddharth, & Mukund, (2010), beside the transferred tasks that define the scope of PPP, it is also important to identify revenue streams to the private entity as well as evaluate which of entities, the public or private one, will assume greater share of demand risk, since this determines whether the social or economic model is applied. If it is planned that more than half of demand risk is assumed by the private entity, this means that the private entity will also have to collect at least more than a half of revenues from the direct users for its efforts. In this case, depending on the scope of transferring tasks, concession, lease, affermage would be right decisions. If the social model is preferable or the only one available in the market, this determines that all or a greater part of demand risk should be assumed by the public sector, which requires that more than a half of revenue of the private entity has to be collected from the availability payments. In this case, once again, depending on the scope of transferring tasks, the forms of service contract, management, O&M and, the most complex, PFI could be applied.

Considering the analysis provided in Section 1.2.2., it is important to emphasize that each of the above-mentioned forms can be modified depending on particular requirements. Modifications can assert in different allocation of tasks and risks, different ownership structure, different guarantees from the public sector, obligations of the private entities, etc. This allows the PPA to be flexible and construct the PPP depending on the possibilities and particular requirements. This may be especially important when the costs and financial sustainability as well as the affordability of the SB are assessed.

The cost of the SB can be assessed from the private and public perspectives. In both cases, the SB consists of the same implicit cost elements: base costs, financing arrangement cost and ancillary cost accompanied by the retained risk by the public sector; however, with the only exemption related to the same retained risk and a part of ancillary costs, there is a difference in respect of their arrangement in the period of PPP and structure of CFs. Figure 1.1[46] and Figure 2.8 show the difference in respect of time and structure of CFs, respectively. From the perspective of a private bidder, costs are started to experience from the beginning of IP implementation and are recognized depending on their actual occurrence (Formula 13). While, from the perspective of the PPA, costs are usually experienced only from the beginning of service delivery and are transformed into unitary availability payments required to be made to the private entity throughout the PPP term (Formula 14)[47]. In some cases, both options can additionally assess the requirement of upfront public subsidies[48]. The retained risk is disembodied from UPs, since its occurrence in respect of time depends more on the actions of the private entity rather than payments of the public sector. The retained risk is added to the cost of private entity to assess the full cost of the IP implementation and service delivery which the public sector is expected to cover in the case of a planned scenario at the chosen, usually 70%, confidence level. While ancillary cost consists of two parts, one of which remains with the PPA and the other, experienced by the private entity, is included in the UPs.

$$SB_{pr} = \sum_{t=0}^{t=n} \frac{BC_t + FAC_t + AC_t}{(1+r)^t} + \sum_{t=0}^{t=n} \frac{Risk_{rtn_t}}{(1+r)^t} \qquad (13)$$
$$BC_t = I_t - RE_t - RV_n + OM_t$$

here: *BC* – base cost, *AC* – ancillary cost, which includes such cost as procurement and other transaction costs.

$$SB_{pu} = \left(\sum_{t=0}^{t=n} \frac{UP_{t \geq m}}{(1+r)^{t \geq m}}\right) + \left(\sum_{t=0}^{t=n} \frac{Risk_{rtn_t} + AC_2}{(1+r)^t}\right) \qquad (14)$$
$$UP \in (I - RE - RV + OM + FAC + AC_1)$$
$$AC = AC_1 + AC_2$$

[46] The differences of CFs under both arrangements are the same as it is the difference between CFs of CP and PPP, where CP represents the private entity's CFs and PPP represents the public sector's CFs, respectively.

[47] If an IP is in general profitable, it also can be transformed into the payments of the private entity to the public sector, which can be foreseen in the RFP as a concession fee.

[48] In some cases, as it is in the EU, governments, obtaining subsidies from the ESI fund, can provide grants to cover the capex made by the private entity right after fully completing the construction phase to make the PPP financially affordable.

here: *UP* – unitary payment, AC_1 – ancillary cost of the bidder, AC_2 – ancillary cost of the PPA.

Beside the retained risk, other significant driver of results of VfM analysis is the assumptions made on the IP costs under the PPP options, particularly, the extent to which the PPP is assumed to achieve lower costs through efficiency or innovation. On the one hand, the PPA may assume that the private sector's entity does not introduce any value-added innovations to reduce the costs of the IP, then the PPP option can conceptually be lower in costs only by the part of transferable risk. However, considering the advantages of PPP discussed in Section 1.2.3, the PPA may expect innovations which can occur when the responsibilities for design, construction, financing, operation, repair and maintenance are assumed by a single entity, who will then optimize the trade-offs that are available between these different cost elements. Herewith it also should be assumed that such innovation is not possible in the case of CP. According to Harada & Ogunlan (2015), the cost of IP implementation also drops due to the effect of competition when the number of bid-participating firms increases.

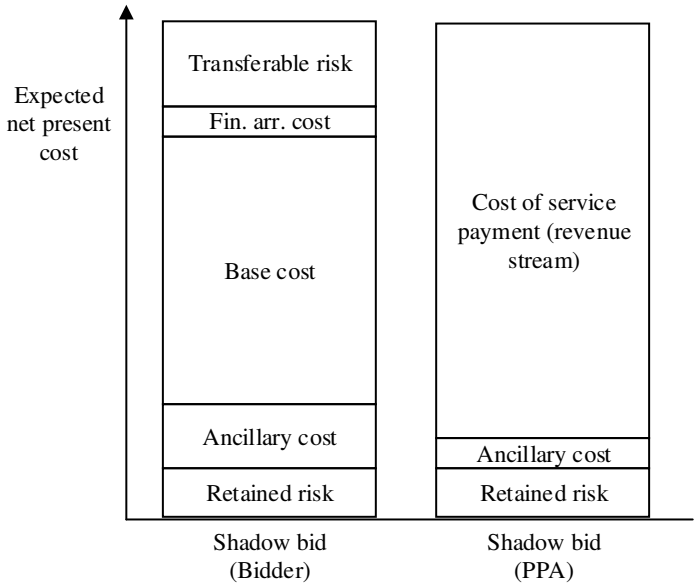


Figure 2.8. A comparison of the cost elements of SB depending on the public or private perspective they calculated (prepared by the author of this dissertation)

The assumption about cost savings requires sufficient empirical data regarding the probability and magnitude of such expected benefits to be quantified and reasonably included in the SB model. Literature, as disclosed in Section 1.2.3., is quite controversial regarding this aspect. However, the examples in the UK and France, presented in the same section, disclose that it would be rational to expected savings not higher than 10%–15% of capital expenditure. Accordingly, there is a particular expectation from the market to compensate a relatively higher transaction cost of PPP procurement.

The particular assumptions are also met regarding other cost as well as revenue elements; however, since there are no reliable data, mostly directions of changes are only indicative (World Bank, 2013). Regarding the revenue, an experience in Korea suggests that tolls on a road IP implemented as the PPP are typically set higher than on public roads, resulting in lower traffic, and most likely differing (lower) revenues. The revenue from ancillary uses of assets is usually assumed to be the same in both cases. However, in such countries as, e.g., France, where administrative law makes it difficult for a government entity to engage in commercial activities that are not core to its function, such additional revenue sources are assumed only in the PPP case. Regarding operational costs, as revealed in the analysis of different practices of VfM assessment provided in Section 1.3.2., there is a noticeable practice to assume them not being identical and make them lower in the PPPs in the countries such as France, Germany, the Netherlands, Australia, since the assumption concerning whole life-cycle cost optimization in the case of PPP is applied. While, regarding the cost to the government of project management and transaction implementation, two main treatments are distinguished: some governments, such as France, adjust both PSC and PPP costs accordingly; while Korea excludes contract management costs from both options. The assumption of higher transaction cost in the PPP is more rational where the PPP implementation framework is relatively poorly developed. All these observations allow arguing that each case requires particular attention; however, the more data are collected and systemized from the practical experience, the more reliable it is to apply the pre-assumptions regarding the adjustment of CFs in the SB model. This shows the requirement for development of IP monitoring framework which would allow monitoring the implementation of an IP and service delivery and collecting the data needed to systemize the general tendencies regarding separate cost elements, as have been done by the author of this dissertation in the case of investment costs.

The above-mentioned assumption related to cost savings is important, since it is considered to implement an IP as an institutional PPP, described in Section 1.2.2. In this case, since the private sector can provide efficiency innovation but also is usually emphasized by a higher cost of capital, the main issue is how to determine the optimal proportion of public and private capital investments, which also determines the scope of PPP, discussed in the previous section. A potential solution is provided by Moszoro (2010, 2014), according to who the optimal capital structure in the institutional PPP can be determined considering the difference in the cost of capital among of the public and private entities and the savings in investment costs which can be achieved if the private sector participates in the implementation of an IP and a sufficient level of know-how is transferred. Figure 2.9 illustrates the interdependence between these variables, the mathematical relations of which are also expressed in Formula 15.

$$f(q) = \Theta * I(q) * r_{pr} + (1 - \Theta) * \left(I(q) + (1 - \beta) * J(q)\right) * r_{pu} \quad (15)$$

here: r_{pr} – capital cost (discount rate) for a private investor, r_{pu} – capital cost (discount rate) for the public sector ($r_{pr} > r_{pu}$), $J(q)$ – amount by which development outlays (without financial costs) for a privately executed project are lower than the

outlays for a publicly executed one, Θ – share of a private investor in the joint venture, $\Theta \in <0, 1>$, β – discrete variable reflecting the existence of know-how in project execution, so that: $\beta = 0$ (when there is no know-how transfer ($\Theta < e$)); $\beta = 1$ (when there is know-how transfer ($\Theta \geq e$)), e – a minimum share of private capital in a joint venture above which know-how is transferred.

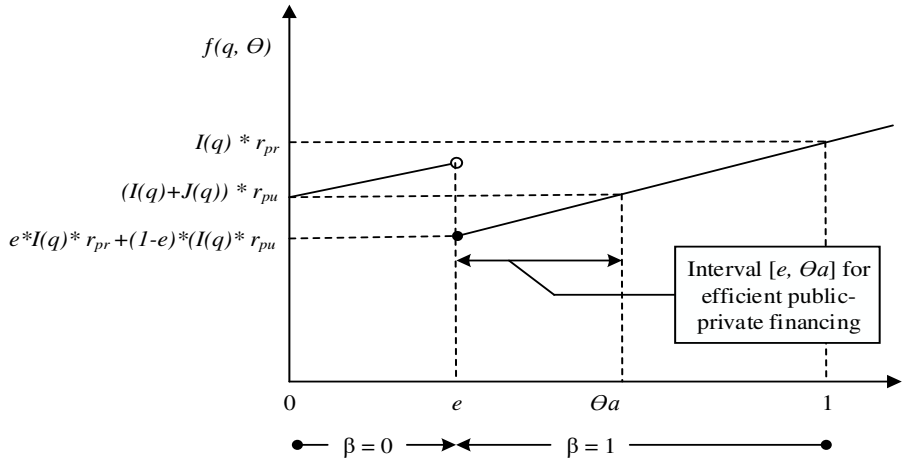


Figure 2.9. Interval of efficient public-private financing (according to Moszoro (2010))

As can be seen from the figure, IP's investment costs start to rise from the point where the IP is realized only by the public sector *($\theta = 0$)*. The *f(q, θ)* increases as a result of the increase of the share of the more expensive private capital in the PPP. The rate of increase for *($\theta < e$)* equals $I(q)*(r_{pr} - r_{pu}) - J(q)*r_{pu}$. At $\theta = e$ the transfer of knowledge occurs and the *f(q, θ)* drops by *$(1 - e)*J(q)*r_{pu}$*. When $\theta \geq e$, the f(q, θ) increases at the rate of $I(q)*(r_{pr} - r_{pu})$. When $\theta = \theta a$, the investment costs f(q, θ) in the PPP become equal to the costs in the IP without the participation of the private sector. Finally, when θ reaches 1, the project shares are held purely by the private entity and costs are equal *$I(q)*r_{pr}$*. This allows concluding that the greater share of private capital is needed, the smaller potential savings from participation of the private sector are, since capital cost and potential savings remain constant. The fluxion of Formula 15 allows determining the optimal share of the private sector participation in the joint venture (Θ*) (Formula 16), while Figure 2.10 shows the share of the private capital in the joint venture PPP.

As Figure 2.10 shows, the know-how starts to be transferred even with little share of the private capital in the general structure of PPP. The optimal capital structure is reached in interval *Θ (0, Θ_a)*, where the total amount of capital cost *f(q, Θ)* is lower than the capital cost of the public sector and the private sector, respectively. Minimal capital cost of IP is reached at the point where a share of private participation is Θ*, where all know-how is started to be transferred to the public sector.

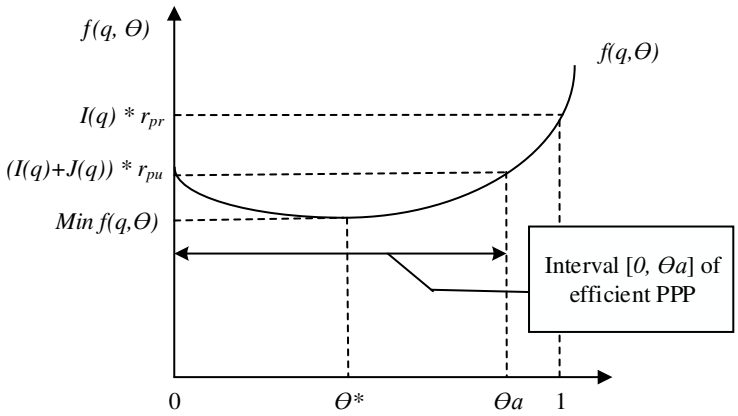


Figure 2.10. The interval of efficient proportion of public and private capital (according to Moszoro (2010))

$$\Theta^* = 1 - \frac{I(q)}{2J(q)}\left(\frac{r_{pr}}{r_{pu}} - 1\right) \tag{16}$$

The above-described solutions of efficient capital structuring can be supported by the proposition of Hemming (2006), who claims that the PPP is an effective way of delivering public infrastructure and service only when the benefit received in a form of potential cost saving (without financial cost) is higher than the increase in the average cost of capital due to participation of the private sector.

Since the optimal proportion of the public and private capital is determined or the PPP is planned to be established on a contractual basis, further, considering the above-discussed assumptions related to the values of CFs, it is important to assess the affordability of SB model's financial structure to the public sector from the one side and financial attractiveness to investors from the other, where the interests of potential financiers also have to be satisfied to make the IP financial viable. This requires optimizing the capital structure of the SPV and, in general, developing a financial model where, as discussed in Section 1.2.4, interests of all the above-mentioned parties have to be satisfied. This can be rather challenging, since the SPV is a distinct legal entity (the project company), the financial model of the SB is based on project finance which refers to the development of a stand-alone IP on a non-resource or limited resource financing, where equity and debt used to finance the IP are paid back only from the CFs generated by the IP.

According to Fischer et al. (2010) and X. Zhang (2005a, 2005b), the success of PPP largely depends on whether it optimizes the capital structure so that the internal rate of return to equity (IRRE) is maximized while satisfying other IP participants' interest and requirements, which are considered to be constraints. The greater IRRE, the more the IP becomes attractive to investors, thus, the more likely they are to assume relatively larger risk. This partially depends on the equity level, which is the most relevant variable that concerns both the public and private sectors. Accordingly, three major parties are concerned with the equity level: 1) investors,

who are equity holders of the IP; 2) financiers or lenders, who lend money to the IP, and; 3) the PPA, which, representing the government, performs procurement as well as might provide guarantees or other types of support to the IP. All these parties, considering their different risk profile, have different views as to what is an appropriate equity level, since their interest are dependent to some extent on the equity level.

For investors, their equity is recovered with an expected level of profit from various tasks transferred by the public sector such as design, construction, O&M, etc. They consider the PPP IP as financially viable, if IRRE is greater than the expected minimum level ($IRRE_{min}$). Equity providers structure their investments to be as efficient as possible. Therefore, they want to maximize IRRE and, keep a low level of equity[49]. Everything that makes risk on equity return is valued with scrutiny. Therefore, according to Zhang (2005b), from the perspective of equity providers, the assessment of SB has to begin with an evaluation of what part of recovery of the equity in the finance of IP will depend on the successful management of long-term project risks (equity at project risk – EPR), the market (demand) risk of which is usually prevailing and the revenue stream generated over the determined PPP/PSC period (Formula 17). Accordingly, the ratio of equity at project risks (REPR) defined as the ratio of the amount of EPR to the total amount of equity can be calculated (Formula 18).

$$EPR = E - \omega \times C_T \tag{17}$$

$$REPR = \frac{EPR}{E} \times 100\% \tag{18}$$

here: *REPR* – ratio of equity at project risk, E – amount of total equity, ω – the profit margin on the construction activity, C_T – total construction cost.

Since EPR includes only that part of equity that is exposed to long-term IP risks, the higher REPR is, the longer the equity holders are intended to be committed to the success of the IP. Therefore, the payback period of EPR may be an appropriate signal of the underlying interests of equity holders, i.e. the shorter the payback period, the less commitment of equity holders. Considering this aspect, the PPA has to calculate equity returns in different scenarios and determine the optimal period of PPP/PSC in an iteration process, which would allow the PPA to suggest a competitive IRRE in the market and, herewith, encourage a long-term commitment from equity holders. Accordingly, Formula 19 represents the net present value of equity holders' total net profit at a specific equity level R discounted to the beginning of the first year of PPP reference period (NPV_P) which, along with IRRE, are fundamental financial decision criteria to assess IP's financial viability.

[49] In addition to conventional equity investments, an efficient structure beside equity investment may also include subordinated debt, which can be provided by the same equity providers.

$$NPV_P = \sum_{j=1}^{n} \frac{NATCI_j}{(1+r)^{j+m}} - \sum_{i=1}^{m} \frac{E_i}{(1+r)^{i-1}}$$

$$NATCI_j = EBIT_j + DE_j - D_j - TAX_j$$

$$EBIT_j = RE_j - OM_j - DE_j$$

$$TAX_j = r_{tax}(EBIT_j - I_j)$$

$$D_j = (1-R)\frac{r_D(1+r_D)^n}{(1+r_D)^n - 1}\sum_{i=1}^{m}\left[C_i(1+r_D)^{m-i+1}\prod_{k=1}^{i}(1+e_k)\right]$$

$$I_j = D_j - DP_j = D_j - \frac{D_j}{\left(1+D_j\right)^{(n-j+1)}} = D_j\left[1 - \frac{1}{(1+r_D)^{(n-j+1)}}\right]$$

$$\text{for } j = 1, 2, \ldots, N;\ i = 1, 2, \ldots, M \qquad \textbf{(19)}$$

here: n – operation period, m – construction duration, $NATCI_j$ – annual net after-tax cash inflow in the jth operation, R – equity level, DE_j – depreciation, TAX_j – tax, D_j – debt installment, N – operation period, M – construction period, r_D – interest rate of debt, r_{tax} – income tax rate, I_j – debt interest in the jth year of the operation period, e_k – construction cost escalation rate for the kth year of the construction period.

To be financially viable, NPV_P must be equal or greater than zero, where IRRE is equal or greater than $IRRE_{min}$. Depending on the economic sector, IRRE can be different. For example, in Lithuania the desired IRRE in the IPs varies from 9% to 11% (Invest, 2015).

For lenders, the equity level is preferred to be high enough to minimize their risks, as debt has a higher rank in repayment than equity investment. To be bankable, the PPP IP has to satisfy a minimum level of annual Debt Service Coverage Ratio (DSCR), which is the ratio of annual cash available to cover annual interests and repayment of principal as defined in Formula 20. The DSCR reflects the IP's ability to carry debt, therefore, it is the main criterion of lenders when assessment of IP's financial viability. The larger revenue stream is during the operation period, the higher annual DSCRs are, the stronger is debt carrying ability of PPP IP. Generally, the DSCR should be at least equal to or larger than 1.0 to be acceptable. However, an IP usually becomes bankable when DSCR is in the rage of 1.10–1.25, while a comfortable level is above 1.3. Regarding the value of DSCR, it is also important to consider that the equity level affects the interest rate of borrowing. Depending on the equity level, a risk premium can be added – the lower equity level, the higher risk premium – since lower equity level means increased risks to the lenders, so that the required level of DSCR may not be satisfied.

$$DSCR_j = \frac{EBIT_j + DE_j - P.TAX_j}{D_j} \quad \text{for } j = 1, 2, \ldots, N \qquad \textbf{(20)}$$

here: *EBIT* – earnings before interest and tax, *P.TAX* – profit tax, *D* – debt installment, *N* – debt repayment period.

Beside the DSCR, another indicator which allows to dynamically check IP's debt carrying ability, is the Loan Life Coverage Ratio (LLCR) (Desgrées du Lou, 2012; Fischer et al., 2010), which periodically (i.e. annually) measures the NPV of the sum of all future income for the life of the loan divided by the outstanding debt at a particular point in the time (Formula 21). Generally, to be bankable, the LLCR of PPP IP should be at least greater than 1. However, LLCR above 1.3 is preferable.

$$LLCR_k = \frac{\sum_{j=k}^{N} \frac{EBIT_j + DE_j - P.TAX_j}{(1+r)^{j-k+1}}}{\sum_{j=k}^{N} \frac{D_j}{(1+r)^{j-k+1}}} \qquad (21)$$

Like LLCR, there is also Project Life Coverage Ratio (PLCR), the IP CFs go of which until the end of the IP. This indicator gives information to lenders to assess whether the IP will generate sufficient revenues after the end of loan in case the debt needs to be restructured. The PLCR above 1.5 is preferable.

Figure 2.11 graphically summarizes the above-presented debt cover ratios. It shows that, to make the SB financially viable, the annual financial status of the IP should be examined, which would ensure that the determined requirement of lenders would be satisfied.

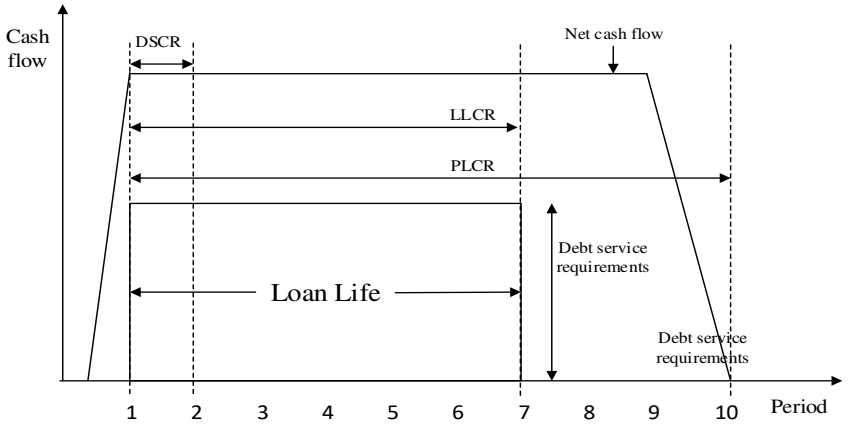


Figure 2.11. The debt cover ratios considered by lenders in PPP projects (according to Desgrées du Lou (2012))

The PPAs seek to ensure that IP would be completed on time and within the planned costs, service would be provided according to the predetermined quality, which would also be financially affordable and the life-cycle cost efficiency would

be achieved. According to Zhang (2005b), successful addressing of these issues requires a suitable capital structure and a long-term commitment of PPP IP participants. As discussed in Section 1.1.1, the PPA, providing the RFP, is responsible for the development of such conditions of collaboration with the private sector, which could encourage the appropriate incentives from all participants as well as ensure the financial viability of PPP in respect of all stakeholders, including the general public, whose dissatisfaction of interest can cause significant political cost to the government. Therefore, the PPA should ensure that a suitable equity level is used to satisfy the interests of equity holders, lenders and the general public.

However, the PPA primarily has to be assured that, considering the requirements of equity providers and lenders, the SB to be rationally compared against the CP, in general can be reasonably expected to be financially sustainable, affordable and secured in respect of public interest.

Regarding financial sustainability, there are two aspects, required to be examined. First, the Self-Financing Ability (SFA) of the SB, which, as defined in Formula 22, is a ratio of the construction cost which can be recovered through the net revenues earned in the operation period, subject to the financing conditions of the capital market and the equity holders' requirements of return to their investments. The higher SFA, the more the IP emphasizes the revenue generating ability that, in turn, discloses a financial status of the IP in operation period. Equity holders usually are only responsible for the arrangement of finance (either through equity or debt) to amount at the SFA level. The non-self-financing part is paid by the government. Therefore, the PPA has to assess the appropriate subsidies, if needed, to make the IP financially sustainable. Especially, this is the case in non-revenue generated IPs. Accordingly, Figure 2.12 shows the structuring of optimal capital in both financially viable and non-viable PPP IPs. When it is self-financially viable, the capital structure model examines the optimal financing mix between equity and debt. Otherwise, the government-subsidized PPP IP is comprised of three financing sources: equity, debt, and government subsidy. For government-subsidized PPP IPs, the appropriate government subsidy level must be determined before the optimal debt ratio can be determined.

$$SFA = \frac{NPV_R}{NFV_C} \tag{22}$$

here: NPV_R – net present value of the net revenues in the operation period, NPV_C – net present value of the construction cost, DR is equal to the risk-free rate plus the market price of risk, which is the premium that investors must receive over the risk-free rate to incur the market $r = r_f + r_p$.

It is no less important to examine whether in the SB the risk of running out of cash in the future in the SB, both during the investment and the operational stages, is expected to be nil, that, in turn, which is the second aspect of financial sustainability. The sources of financing available (both internal and external) should consistently match disbursements year-by-year, where the deficit or surplus is accumulated. The IP has to generate a positive cumulative cash surplus over its life (Formula 23).

Therefore, in the case of non-revenue generating IPs or whenever negative CFs are projected in the future clear long-term commitment to cover these negative CFs considered as financial gap must be provided.

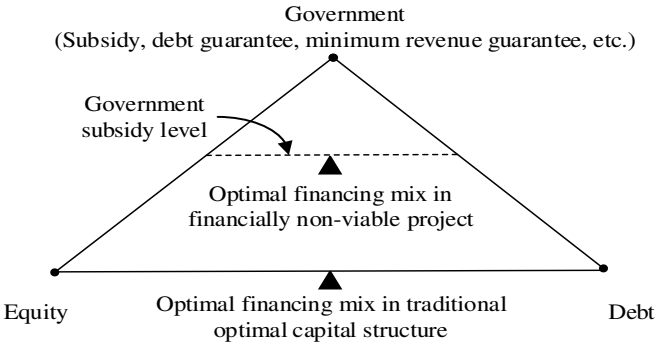


Figure 2.12. The optimal capital structure and government subsidy (according to Chen et al., 2012)

$$\sum_{i}^{n}(CI_i + CO_i) \geq 0$$

$$CI_i = SF_i + RE_i + S_i + RV_i$$

$$CO_i = I_i + OM_i + FC_i + TAX_i \qquad \textbf{(23)}$$

here: *CI* – cash inflows, *CO* – cash outflows, *SF* – sources of financing, *R* – operating revenues from the provision of goods and services, *S* – subsidies and other financial gains not stemming from charges paid by users for the use of the infrastructure, *RV* – residual value, which should not be taken into account unless the asset is actually liquidated in the last year of the PPP, *FC* – reimbursement of loans and interest payments, *TAX* – taxes on capital/income and other indirect taxes including VAT.

Once the financial commitment needed from the public sector is evaluated, SB's affordability to the public sector has to be examined, since there is no aim to presume that a developed SB represents good VfM, if it is actually not affordable to the public sector. Accordingly, the PPA's capability to cover the expected financial commitment (i.e. UPs) to the private entity is one of the most important factors for expedience to implement IP as the PPP.

To check affordability, as distinct from the CP, where the government has to fund initial investments and operation, financial commitment to the private sector is rearranged by equal parts as service or availability payments through the entire operation period of PPP, as has been explained in Section 1.2.1. These UPs have to be compared against the financial possibilities of the public sector to cover them year-by-year during the appropriate period of PPP. Here it is important to consider that the private entities will include the value of risk in their proposals, therefore,

UPs have to be risk-adjusted[50] and the appropriate funding has to be foreseen in the budget. Moreover, if an IP requires to increase the price of services which are paid by the direct users, the affordability of the increased price to society needs also to be evaluated to ensure the viability of PPP IP in respect of the general public.

Since all the above-indicators are dependent on the number of stochastic variables, such as market demand, debt interest rate, O&M cost, inflation rate and others described in Section 2.1.3., the above-presented financial commitments of the public sector in forms of UPs can be considered as particular guarantees to the private sector, which is the common feature of PPP contracts to make PPP financially viable (Hemming, 2006). UPs are usually proportionated to the retained demand risk of the public sector, i.e. the public sector purchases a particular amount of service equivalent to the amount of funding needed to ensure the financial viability of PPP IP. This is related to the logic of risk allocation, explained in Section 2.1.3., that the demand risk is normally considered to be an operating risk that should be borne by the private sector; however, if the government is the sole or main consumer of services, it should bear the demand risk.

Beside the commitment to provide payments, the PPA's guarantees can take a variety of other forms, including subsidies, grants, tax breaks, capital injection, etc., which have been analyzed in Section 1.1.1.2. These guarantees, since they can be an effective response to the inability of the market to distribute risk optimally, decrease the risk of the equity providers as well as lenders. Therefore, it is often necessary for the PPA to provide investors with certain guarantees that relieve some of the risk shouldered by the private parties to attract investments. However, guarantees also increase commitments of the public sector in the PPP, which can be not affordable due to the budget constraints. Therefore, it is relevant to primarily use possibilities which are provided by determining different duration periods of PPP and tax exemption, and only then assess the needs of payment or subsidies from the public sector. For rational comparison, any tax exemption due to affordability reasons included in the SB has to be consistent with the PSC. However, any payments and guarantees from the public sector have to be the object of competition and negotiation rather than directly included in the RFP. Otherwise a "guarantee culture" can be created, leading the private sector (and, in some cases, international financial institutions and bilateral lenders[51]) to seek guarantees as an alternative to properly managing risk themselves.

Since the public sector provides minimum revenue guarantees for the private entity based on the principle that the benefits one receives should be fairly equal to the risks taken, the PPA has the right to share any excess revenue the investors gain equal to the difference between the actual revenue gained by the investors and the cap of the expected earnings. As a result, the excess revenue sharing ratio should be determined. While a reasonable risk-sharing system determines whether project

[50] The payment to the private entity can also be the object of VAT taxation.

[51] The analysis of RFPs in Lithuania discloses that the lender usually requires guarantees of full loan and interests recovering from the public sector, despite of whether the PPA or the private entity would be responsible of a cancellation of PPP.

financing will be successful. This issue is relevant in concessions, where the revenue stream depends on the demand of direct users and their money paid for obtainable services. Accordingly, the evaluation of guarantees and excess revenue sharing is currently a developing topic in the research field (Asao et al., 2013; Hemming, 2006; Huang & Chou, 2006; Takashima et al., 2010; Andreas Wibowo et al., 2012). However, scientific studies are still quite fragmentary and complicated to be adopted in practice, especially regarding the issue of excess revenue sharing.

Yinglin Wang & Liu, (2015) argue that the excess revenue sharing ratio can be determined considering the fairness preferences and effort cost coefficient of the investors. This model integrates the fairness preference theory with the traditional principal–agent model to calculate optimal incentives when principals (governments) employ agents (investors) who have fairness preferences. However, the limitation of this model is that it is based on net revenue, which are a result of both revenues and costs, and therefore, due to asymmetric information conditions and the principal–agent problem discussed in Section 1.1.1., can easily become the object of manipulation. Moreover, the PPAs are unlikely to get complete information from (potential) investors needed calculate the output results, resulting in an asymmetric information condition. Specifically, the effort level of (potential) investors cannot be observed. This causes the issue of reliability. However, this study, summarizing the researches, suggests that the sharing ratio of private entity should be higher than the public one, to increase the proper incentives to the private entities.

Brandao & Saraiva (2008) simply suggest determining revenue floor, to which the public sector would provide revenue guarantees, and revenue ceiling, above which revenue would accrue to the PPA, considering Formula 24. The determination of minimal and maximal revenues is based on the Monte Carlo simulation.

$$R_t = min\{max(R_t, P_t), T_t\} \tag{24}$$

here: R_t – observed level of revenues, P_t – level of revenues of the demand floor, T_t – level of revenues of the traffic ceiling.

Considering the limitation of available researches concerning the determination of excess revenue sharing in the PPP in literature, the author of this dissertation, summarizing the observed practice, provides the following solutions. First, the excess revenue sharing ratio should be applied, since it is not effected by costs and, therefore, is more transparent in comparison with ratios related to net revenues (income). Second, marginal annual revenue flow (MARF), above which income are shared according to the ratio applied, should be the object of competition, where the winner proposal could suggest the lowest MAIF, since the ex-ante determination of any income threshold would mean that the public sector would retain the demand risk. Third, considering the model of Yinglin Wang & Liu (2015), it is recommended to determine a ratio where a share of the private entity equals to or is greater than 50%.

Since different views and requirements of all stakeholders concerning financial viability of the IP as the PPP are presented, the optimization of the financial

structure of the PPP can be considered as a system of appropriate equations where all of the following conditions must be satisfied at a minimum level of equity (System of inequalities, classified as Formula 25):

$$
\begin{aligned}
&R \geq R_{min} \\
&IRRE \geq IRRR_{min} \\
&REPR \geq REPR_{min} \\
&DSCR \geq DSCR_{min} \\
&LLCR \geq LLCR_{min} \\
&PLCR \geq PLCR_{min} \\
&SFA \geq SFA_{min} \\
&\sum_{i}^{n} (CI_i + CO_i) \geq 0 \\
&\textit{Affordability of payments} - \textit{Yes}
\end{aligned}
\tag{25}
$$

To solve the system of equations, the results with every $R_k \geq R_{min}$ have to be calculated, as it is described more detail in the article prepared by Jasiukevicius & Vasiliauskaite (2012). The satisfaction of all above-provided conditions shows that the SB, representing the expected cost of PPP, in principle, is financially viable and affordable, therefore further VfM assessment is rational. If there are no iterations satisfying the above-provided conditions, it is rational to extend the reference period and repeat iterative calculations with different levels of equity. If all possibilities to extend the reference period reaches the limit and there are not iterations satisfying conditions, this means that the SB is not financially viable or affordable. Therefore, to continue the assessment of PPP's possibilities to optimize investments in public infrastructure, the scope of the IP has to be changed or it has to be delayed until the public sector has more financial possibilities to ensure the financial viability of the IP.

Summarizing the methodological aspects of SB designing, the financial model of the expected PPP is the result of the public sector's efforts to evaluate possibilities of the private sector to provide public infrastructure and services at the best available alternative risk allocation and payment mechanisms. It includes the assessment of cost as well as financial viability and affordability, the reliability of which as well as further decision regarding the procurement of an IP as the PPP highly depends on the quality of the PSC which is used to develop the SB models, and the assumptions concerning the private sector's cost efficiency, innovation and specific requirements.

2.1.5. VfM assessment

Since the structuring of the PSC and the SB model has been analyzed, this section is devoted to a methodological analysis of the final step in the assessment of PPP's possibilities to optimize investments in public infrastructure, i.e. VfM analysis as an assessment tool to compare the impact of PPP IP against those for the traditional public delivery alternative. It is important to note that to be rational to use it requires an "apples-to-apples" comparison. Therefore, consistency among the PSC

and the SB has to be ensured in respect of the scope and main assumptions of IP to get reliable results. While, VFM analysis, considering the analysis provided in Section 1.3., typically involves a combination of quantitative and qualitative assessments, which, as two major components, are analyzed below.

The quantitative VfM analysis mostly focuses on the comparison of financial impact of the estimated risk-adjusted cost elements to the public sector in each of the procurement options. As discussed in Section 1.3.1, it is important to consider that costs included in the assessment can be different depending on the perspective: the PPA or the public sector, from which the assessment is performed, since a part of costs related to tax payment may not be directly recovered as revenues by the PPA. Differences can be also observed depending on whether the PPA represents a national or regional government level.

As analyzed in Sections 2.1.3–2.1.4., the comparison of the public sector's cost typically includes the procurement cost, retained risk cost, base cost, ancillary cost and financing arrangement cost. Beside these costs of financial nature related to the IP implementation and service delivery, it can also include NFBs, which represent external socio-economic benefits to society raised due to the implementation of IP as the PPP. Since the affordability issue which causes the postponement of IP implementation is one of the major reasons to initiate the assessment of possibilities to implement an IP as PPP, earlier availability of infrastructure and services and the resulting benefits are the most common NFBs included in the quantitative assessment.

Figure 2.13 graphically shows a hypothetical comparison between the PSC and the SB in the social-based model, i.e. services are free of charge to the direct users and all costs are covered from the public budget.

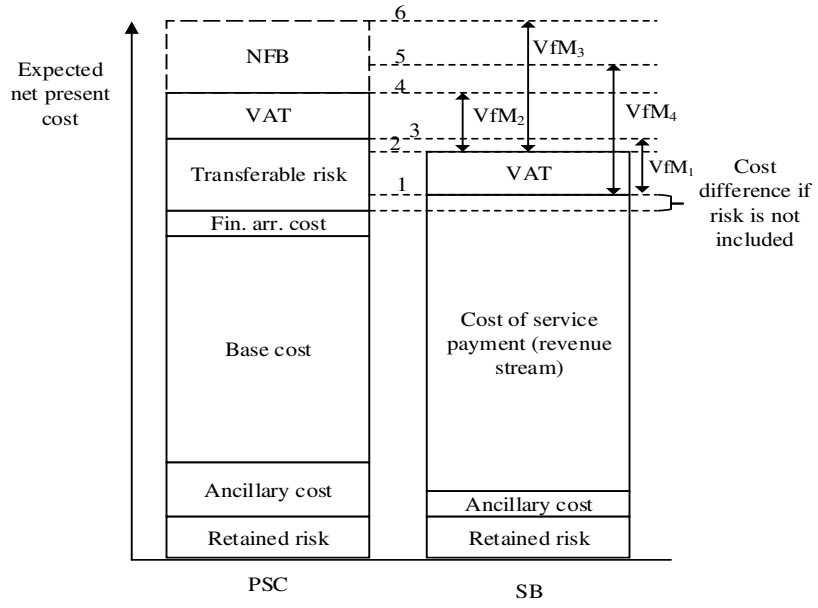


Figure 2.13. Calculation of quantitative VfM in the social-based model (prepared by the author of this dissertation)

As shown in Figure 2.13, in procurement of PPP, the PPA trades away significant risks (transferable risk) in exchange for higher baseline and financing arrangement costs, which, beside other costs experienced by the private entity, are included in UPs paid to the private entity in the PPP scenario. The distance between line 1 and line 3 shows VfM_1 for the public sector. If VfM is assessed from the perspective of the PPA, both options have to be increased by the VAT. The distance between lines 2 and 3 shows VfM_2 for the PPA, accordingly. When NFBs are included in the comparison, the distance between lines 2 and 6 represents VfM_3 for the PPA, while VfM_4 shows the quantitative benefits of IP implementation as the PPP for the public sector. Here $VfM_3 = VfM_4$. The figure also shows that if risks are not included in the comparison, the PPP option costs more for the private sector than the implementation of IP in the conventional way.

Figure 2.14. presents the comparison between the PSC and the SB in the economic-based model, where most of private entity's revenue is received from direct users; however, they are insufficient to make the PPP financially viable, therefore, subsidies from the public sector are required. In comparison with the social-based model, the base costs are lower here, since a part of costs is covered by the revenues. The comparison also does not include VAT, since, in this case, the activity is taxable by VAT which can be recovered. Here it is also assumed that the price of service does not change due to the private sector's participation in their provision. Therefore, the distance between dot lines 1 and 3 shows VfM_5, which is cost-saving or has lower impact on public budget expected to be caused by private participation. The distance between lines 1 and 2 shows this benefit if risks are included in the comparison. While VfM_6 shows the benefits for the private sector, or the PPA, if NFBs are included in the comparison, accordingly.

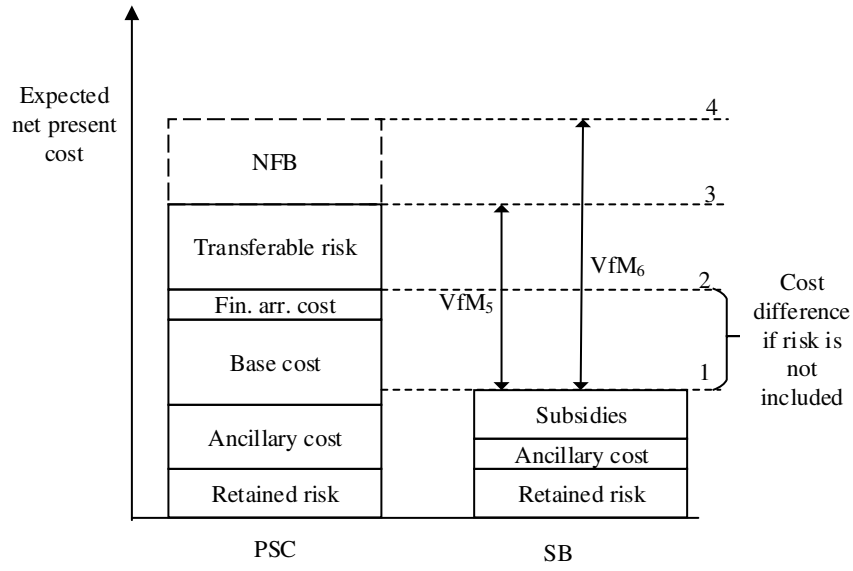


Figure 2.14. Calculation of quantitative VfM in the economic-based model with the subsidies to the private entity (prepared by the author of this dissertation)

The situation similar to the above-presented case is shown in Figure 2.15, where the private entity, due to the provided efficiency innovation, gets net revenue above the determined level of equity return and, therefore, can be charged a concession or another similar fee, which has to be paid to the PPA. It is assumed that this fee is equal to the sum of costs which include ancillary costs and costs of retained risk (distance *a* = distance *b*). Therefore, financial benefit received by the public sector/PPA covers the expected costs of IP implementation as the PPP. This also means that the PPA is secured by the price of services, which could be lower to the users if the PPA would bear the above-mentioned costs *a* without financial compensation asked from the private entity *b*. Therefore, in this case the PPA can generally choose among two options: a) to leave the price level in the RFP as determined in the PSC, or: b) to determine a relatively lower price level, if the options, especially the last one, are financially viable, as discussed in Section 2.1.4. Accordingly, VfM_7 shows financial benefit for the PPA/public sector if the price level remains the same, and VfM_9 if the price level becomes lower. VfM_8 and VfM_{10} show benefit for the PPA/public sector if NFBs are included in the comparison. VfM for the society is equal to NFBs if the price level remains the same as in the PSC, and NFB + b if the price level is decreased. This allows arguing that the interest of public sectors' authorities regarding the implementation of an IP as a PPP can differ from the interest of users, who directly pay for the services or availability of infrastructure.

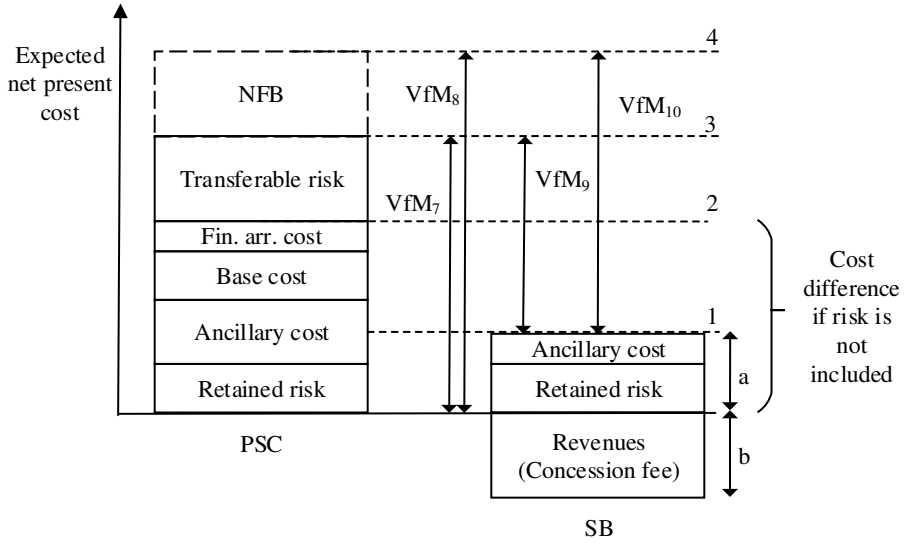


Figure 2.15. Calculation of quantitative VfM in the economic-based model with the possibilities to charge the private entity (prepared by the author of this dissertation)

Figure 2.16 shows a hypothetical case where revenue is generated in both PSC and SB covering other costs of the PPA (*a* = *b* and *c* = *d*); however, the IP, due to financial issues, e.g. budget restrictions on borrowing, is not affordable to be implemented by the public sector in the traditional way, or the provision of service is simply considered to be transferred to the private sector. Here the revenue is

proportional to experienced costs, i.e. the PPA transferring tasks and associated risk to the private entity also transfer the possibility to get revenues from the performed activity. Therefore, the quantitative VfM of the PPA is equal to NFBs, which are caused by the possibility to have services available earlier due to the participation of private financing. If the price level in the SB was lower by a distance b, then VfM for society would equal NFBs + *d*, i.e. service would be available earlier and cheaper. However, in this case, VfM for the PPA would be equal to zero, because NFBs would equal the assumed costs.

Regarding Figure 2.16, the case where the implementation of the IP as the PPP means higher price level for users in comparison with the PSC to make the PPP financial viable is also possible. In this case, the cost of PPA remains the same; however, higher price level decreases benefits for the users, which are related to earlier provision of services. From the perspective of users, the PPP is VfM since the sum of NFBs is higher than the sum of additional revenue collected due to a higher price of service. If this difference is negative, this means that the PPP does not provide quantitative VfM.

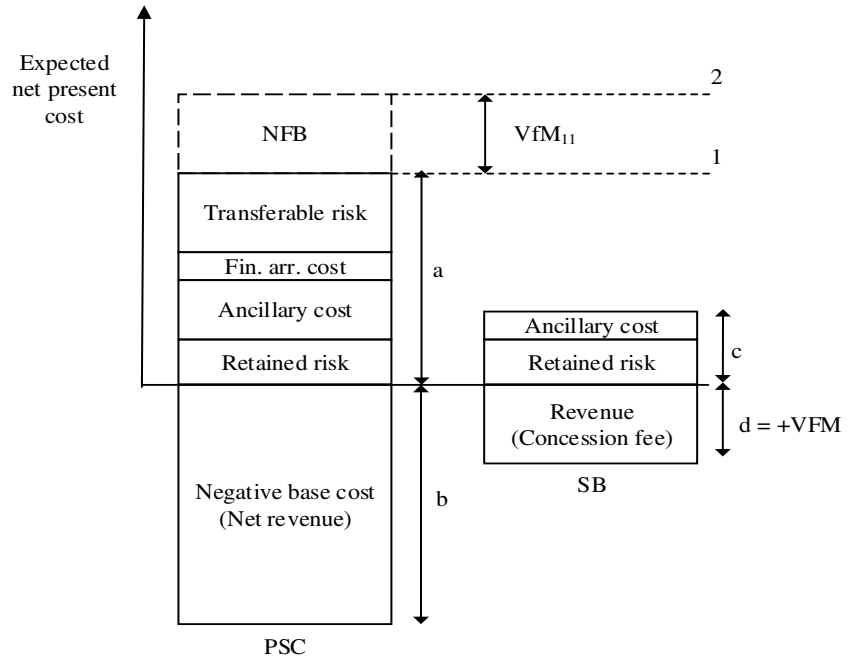


Figure 2.16. A calculation of quantitative VfM in the economic-based model where the activity is profitable (prepared by the author of this dissertation)

However, VfM analysis, as discussed in Section 1.3.1., may be extended beyond the quantitative assessment of IP costs and the final outcome is usually based on both quantitative and non-valued effect components. VfM may also involve substantial qualitative factors that could have a strong impact on the final decision. Their examples, covering the aspects of viability, achievability, performance, have been provided in the same section. Since they are related to the goals and objective of the PPA of increasing service quality, reliability, safety, etc.,

which guide the developers through the planning and procurement stages, the qualitative assessment can be given equal or more importance relative to the cost factors. The weight of qualitative assessment especially increases when the differences between the quantitative results for the PSC and the PPP option are very small, or when there is a high level of uncertainty around the input variables used in the calculation of costs and the outputs are highly sensitive to those input variables.

To get a full view on evaluating the options, Multiple Criteria Analysis (MCA), based on numerous criteria, including quantitative VfM, is used. This approach is used to evaluate potential investment options against criteria considered as critical for the IP's goals and objectives. It is up to the decision makers to decide which criteria are relevant to use and are the most important by applying "importance weights". The main output from the MCA is a matrix that summarizes how each procurement option considered scores against the criteria. The option with the highest scores is considered as the most beneficial.

Table 2.6 provides a hypothetical example of the MCA, where the weight of quantitative assessment has 60 scores in total, while the qualitative criteria includes 40 scores. All scores have been calculated, using Formula 26, and compared to the PSC and SB/PB. The summarized results show that SB/PD option is emphasized by higher costs. However, when the non-valued effects are included in the comparison, scores of the SB/PB become 9% higher showing that the PPP option provides more benefits than the risk-adjusted CP option. This demonstrates that, in this example, the non-valued effects are a critical factor on decision-making regarding the implementation of an IP as a PPP. Herewith, given the fact that this is just an example, developers are free to choose the appropriate combination of criteria and their weights depending on particular requirements. Unfortunately, this determines that the use of this technique remains subjective regarding the assessment process. However, the results allow the PPA to communicate the decision taken regarding the chosen way of IP's implementation by evaluated arguments, e.g. earlier availability of infrastructure in total provides more benefits than in a comparison higher costs of these public goods' delivery, which, in turn, makes the entire process of selection and implementation of PPP IP more transparent.

Table 2.6. Hypothetical MCA framework (prepared by the author of this dissertation)

Criteria	Scores		Comparison to each other		Weight in total	Full Scores	Full Scores
	PSC	SB/PB	PSC	SB/PB		PSC	SB/PB
Innovation[1]	6	10	0,60	1,00	15	9,0	15,0
Service delivery outcome[1]	7	9	0,78	1,00	10	7,8	10,0
User satisfaction[1]	7	10	0,70	1,00	15	10,5	15,0
Risk adjusted NPC[2]	45	49	1,00	0,92	60	60,0	55,1
					Total:	87,3	95,1
					Diff.		9%

[1]*Scores of maximum 10, where 10 is the best and 1 - minimum*

[2]*cost (m.. Eur)*

$$FS = NVE + NPC$$
$$NVE = \sum_{i}^{n} (\frac{B_i}{Bi_{max}} \times X_i) \quad (256)$$
$$NPC = \left(\frac{C_{min}}{C}\right) \times X_i$$

here: *FS* – full scores, *NVE* – non-valued effects, X_l – criteria weight, B_i – socio-economic impact to society, *C* – risk-adjusted costs.

The qualitative assessment as well as quantitative assessment of VfM, which are the focus of this dissertation, have to be revised at every stage of the IP, especially before making a decision for starting the procurement for PPP and when bidders' proposals are provided to find the optimal solution (preferred bidder (PB)) for the implementation of the IP, since the actual proposals, e.g. due to different assumption of demand, capital investments, can significantly differ from what has been assumed by the public sector. The actual proposals can show that the PPA has not foreseen some relevant factors which have significant impact on the output results of the IP. Therefore, for rational assessment, the PSC, as a benchmark, has to be adjusted according to the relevant assumptions used in the actual proposals of the private bidders, if needed. Finally, if the IP is implemented as a PPP, an ex-post analysis is relevant to get empirically-grounded data which could be used to support the assumptions for other ex-ante analyses for the assessment of PPP's possibilities to optimize investments in public infrastructure.

Concluding this section, reliable assumptions regarding the development of both the PSC and the SB options is the key factor determining the quality of assessment for expediency and benefit of PPP to be chosen instead of CP as a delivery option of public infrastructure and services. VfM assessment is complex and, to get a full view of options, requires including both quantitative and qualitative elements as well as needs to consider that benefits of PPP can be different depending on the beneficiary.

2.2. Formation of the model for assessing the possibilities of PPP to optimize investments in public infrastructure

As discussed in previous sections, the assessment of PPP possibilities to optimize investments in public infrastructure includes many aspects which need to be considered and is more a set of various steps which have to be coherently overcome until the expected value of private sector's involvement in the provision of public infrastructure and services can be realized rather than the action of single assessment. Considering the complexity of this process, this section is committed to systemize all the previously analyzed theoretical solutions into an integrated complex model as a solution algorithm enabling the PPA to make reasoned decisions for the expediency of IP implementation as a PPP. The model is suitable to set up the objective of maximizing benefits of the public sector from the private sector's involvement in the provision of public infrastructure and services, while

subjecting this objective to the requirements formulated as constrains of equity providers and lenders. This allows achieving win-win results for both public and private sectors.

Considering the analyzed methodological aspects of the assessment of PPP's possibilities to optimize investment in public infrastructure, this process can be divided into five major steps, which are considered as the main stages of the proposed model. The stages (as shown in Figure 2.17) are as follows: 1) Initial IP preparation; 2) IP selection for PPP; 3) PPP structuring and feasibility analysis; 4) VfM assessment of actual bids, and; 5) VfM monitoring. Since the methodological aspects related to each of these stages have been analyzed in previous sectors, here it is focused on the solution algorithm allowing the PPA to achieve the above-mentioned goals. Besides the general algorithmic-model, some stages are elaborated in the more detailed figures.

Stage 1: Preparation of the initial public IP. As discussed in Section 2.1.1, the reliability of results of the assessment of PPP's possibilities to optimize investments in public infrastructure highly depends on the quality of the IP, based on which the PPP is further assessed. Accordingly, this stage, as elaborated in Appendix 11, has to be performed on the following algorithm:

1. Public services' (PS) context analysis.
1.1. Definition of PS.
1.2. Analysis of PS' socio-economic and legal context, where their unsatisfied demand in respect of quality and quantity or/and inefficiency of provision would be disclosed.
1.3. Identification of the main problem from the observed dissatisfaction of requirements related to PS's quality, quantity and inefficiency of delivery.
2. IP's content analysis.
2.1. Determination of the purpose and tasks of IP implementation.
2.2. Identification of the PPA in respect of administration level, i.e. national or regional level.
2.3. Determination of minimum results which must be the least achieved by implementing the IP.
3. Option analysis.
3.1. Identification of all possible tasks for IP implementation.
3.2. Structuring of the options. Each option must achieve at least the minimum results of IP implementation determined in step 2.3.
4. Analysis of option No. 1.
5. Financial analysis of the option.
5.1. Development of work breakdown structure.
5.2. Schedule network building.
5.3. Calculation of capex.
5.3.1. Setting of start and finish time of each work activity.
5.3.2. Determination of IP's construction period.
5.3.3. Determination of construction cost of each activity.
5.3.4. Calculation of I_t, RV_n.

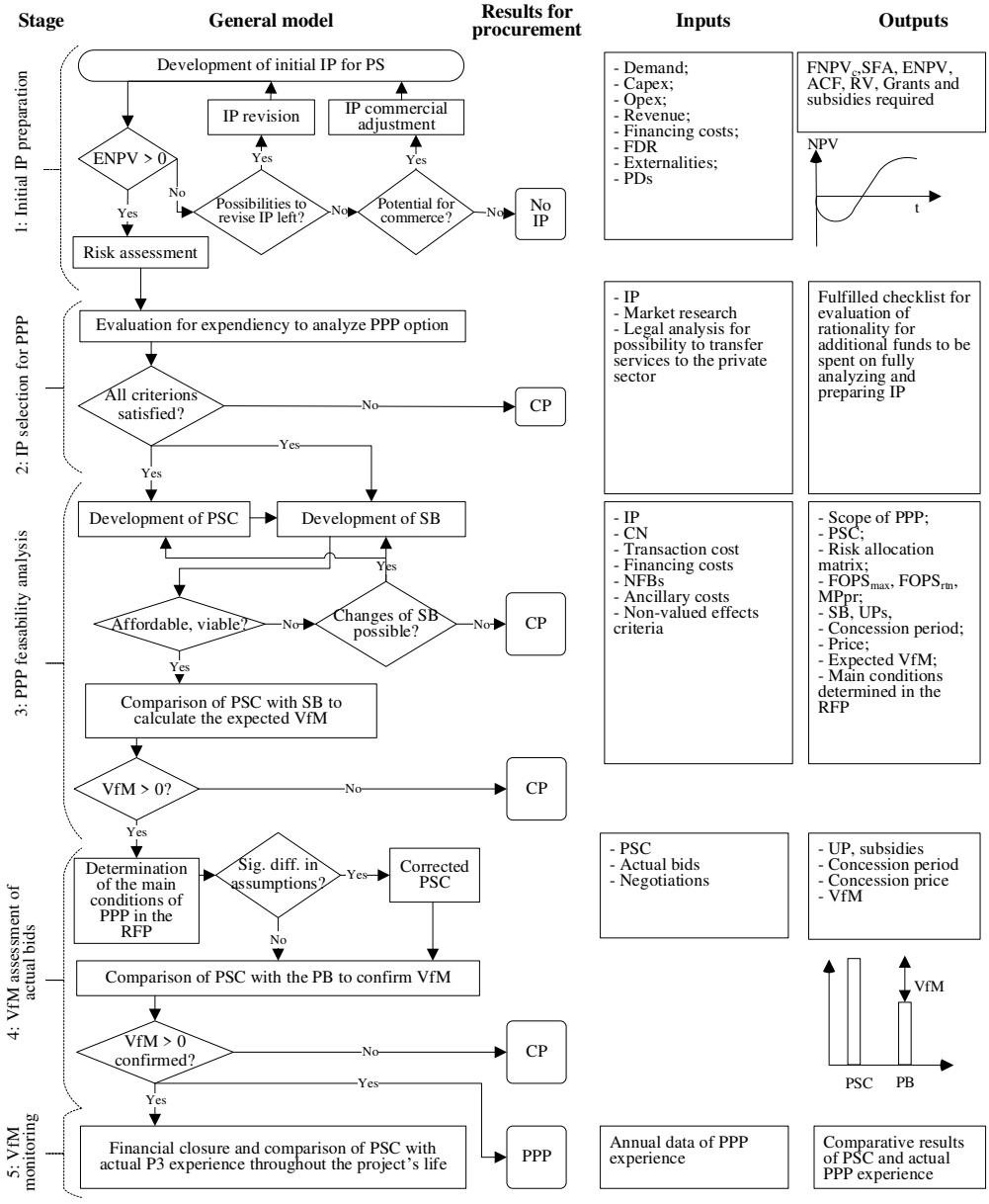


Figure 2.17. General model of assessing the possibilities of PPP to optimize investments in public infrastructure (prepared by the author of this dissertation)

5.4. Calculation of opex.

5.4.1. Setting the time of operation period.

5.4.2. Calculation of RE_t, OM_t, FAC_t, PC_t, POC_t, taxes, financing.

5.5. Determination of FDR, based on the model presented in Figure 2.1.

5.6. Calculation of $FNPV_c$, according to Formula 7 as well as SFA, IRR, CCF.

5.7. Evaluation of financial sustainability of the option, i.e. CCF must be equal to or above 0, therefore if CCF >= 0, go to step 6, otherwise go to step 5.8.
5.8. Change of assumptions or/and specify the option, then go to step 5.
6. Socio-economic analysis of the option.
6.1. Conversion of market price into the shadow (economic) prices.
6.2. Determination of SDR.
6.3. Calculation of option's direct socio-economic impact on society and externalities.
6.4. Calculation of ENPV, EIRR, ECBR.
6.5. The option provides socio-economic benefits to society when its ENPV is above 0. If ENPV > 0, then go to step 6.10, otherwise go step 6.6.
6.6. Checking whether there are possibilities to revise the option left. Then, if there is, go to step 6.7, otherwise go to step 6.8.
6.7. Revision of the option and go to step 5.
6.8. Evaluation of possibilities to add commercial activities. Then, if there is a possibility to do so, go to step 6.9, otherwise, eliminate the option and go to step 6.10.
6.9. Including commercial activities, then go to step 5.
6.10. Evaluation of whether all options have been analyzed. If there are any options left, take another option (option x + 1) and repeat the evaluation from step 5. Otherwise go to step 6.11.
6.11. Evaluation of whether there are options with positive ENPV. If yes, go to step 6.12, otherwise the IP cannot be implemented. STOP.
6.12. Identification of an alternative with the maximum ENPV.
7. Risk assessment of IP. Here, the approach graphically shown in Figure 2.4 is suggested, the graphical algorithm of which is provided in Appendix 12.
7.1. Identification of relevant RGs. It is suggested to apply the scheme of 8 RGs proposed in Table 2.5.
7.2. Attribution of CFs to the appropriate RG as suggested in Table 2.5.
7.3. Estimation of risk measures of RGs, applying PDs and their parameters suggested in Table 2.2 and Table 2.4.
7.4. Calculation of risk-adjusted indicators: $FNPV_c$, IRR, SFA, CCF.

All the above-provided steps enable the PPA to prepare the IP which could offer the highest social-economic benefit to society, if it were implemented in the way of CP. This is an essential condition, since the prepared initial IP is the basis for any further analysis of the possibilities to increase its cost-efficiency, innovation or better affordability to the public sector due to the involvement of private sector in the provision of public infrastructure and services.

Stage 2: IP selection for PPP. Since the PPP procurement, due to complex reasons, can be costlier than CP and requires special conditions to be successfully implemented, this stage of the model, as shown in Figure 2.17, is used to select IPs characterized as having PPP potential and, therefore, would be justified for additional funds spent on their full analysis regarding the possibilities and benefits of their implementation as PPPs. Considering the analysis performed in Section 2.1.2., Table 2.7 summarizes the criteria enabling the PPA to select a suitable

candidate IP for further assessment of their possibilities and benefit to be implemented as PPPs.

Since all the above-provided questions are related to the main features of PPP, each of them, regarding further assessment of PPP's possibilities to optimize investments in public infrastructure, requires a positive evaluation "Yes"[52]. Here the evaluation of question number 5 can require separate legal analysis, while, the evaluation of question 7 is usually based on market research.

No.	Criteria	Yes/No
1	Is there a requirement to invest a significant amount in infrastructure?	
2	Is long-term demand for infrastructure and service planned to deliver in the PPP?	
3	Is it possible to expect benefits form an integration of tasks of infrastructure development and service delivery?	
4	Can the outputs of service performance be clearly measured?	
5	Is it possibilities to share and allocate risks between the public and private sectors?	
6	Can revenue stream to the private entity be clearly identified?	
7	Is there any interest in the IP from the private market?	

Table 2.7. Criteria enabling the PPA to select IPs having PPP potential (prepared by the author of this dissertation)

Stage 3: PPP feasibility analysis. When an IP candidate for PPP is selected, feasibility analysis for its implementation as the PPP, has to performed. As shown in Figure 2.17, this primarily includes the development of PSC and later the development of an SB model. As shown in Appendix 13, the development of PSC includes 5 the main steps which can be coherently accomplished through the following algorithm of steps:

1. Adjustment of the initial IP.

1.1. Evaluation of whether the scope of PPP in respect of the number of tasks is different from the initial IP. A comparison of a hypothetical example is provided in Table 2.3. If yes, adjust I_t, RV_n, RE_t, OM_t, FAC_t, PC_t, POC_t, taxes. Otherwise, go to step 3.2.

1.2. Calculation of adjusted Raw PSC and SFA, IRR.

2. To enable the private sector to compete on the same-level playing field, calculation of CN of the public sector as well as the PPA is necessary, if the PPA represents the municipality level. Depending on the case, this can include land and asset taxes, PPP monitoring tax, contribution for municipality[53], etc.

[52] The particular exception could be the first three questions in respect of a situation where management, lease and similar operating agreements are also considered as forms of PPP. However, this is not the case in Lithuania.

[53] A practice is observed in the economic model of PPP (concession), where municipality asks the private entity to do additional work for giving a right to the private entity to provide

3. Risk assessment.

3.1. Assessment of risks based on the PDs, presented in steps 7.1–7.4 of stage 1. If the scope of PPP is the same as in the IP, the same risk estimates can be used.

3.2. Identification of relevant RFs in all RGs, as shown in Figure 2.4.

3.3. Allocation/sharing of RFs among the public and private entities, based on the scheme suggested in Figure 2.5.

3.4. Calculation of values of retained risk and transferring risk, both of which are used in calculation in PSC.

4. Assessment of NFBs. All NFBs must be monetized. Here the methodology developed by CPVA (2014b) can be used.

5. Calculation of PSC, which is a sum of Raw PSC, CN costs, NFBs and value of retained and transferring risks.

6. Calculation of $FOPS_{max}$, $FOPS_{rtn}$, MP_{pr}, based on Formulas 10, 11 and 12, respectively.

The result obtained by following the above-presented steps is used as a benchmark for the assessment of PPP's possibilities to optimize investments in public infrastructure. Accordingly, the other side of comparison, presenting the expected PPP option which is considered as the SB model, has to be developed based on the following algorithm:

1. Determination of the scope of tasks used in the calculation of PSC. Adjustment of I_t, RV_n, RE_t, OM_t, FAC_t, PC_t, POC_t, and taxes according to the assumptions regarding cost-efficiency and innovation of the private entity. The statistics of past experienced are preferred.
2. Choosing a basis of PPP according to the algorithm presented in Appendix 14. Evaluate whether strategic importance is so high and the specificity of goods and services is relatively low that it would be rational to establish the PPP on an institutional basis. If yes, "Divestiture" as the form of PPP is analyzed, go to step 3, otherwise go to step 11.
3. Comparison of base costs of PSC and PPP. Evaluation whether there is any significant cost saving. If yes, go to step 4, otherwise go to step 11.
4. Calculation of the optimal share of the public and private capital, according to the algorithm presented in Appendix 15.

4.1. Input data: r_{pu}, which is equal to FDR, calculated in step 5.5 of stage 1, r_{pr}, I_q and J_q.

4.2. Calculation of Θ^* based on Formula 16, which is graphically shown in Appendix 15.

4.3. Determination of Θ (share of private capital) and $(1 - \Theta)$ (share of public capital).

5. Optimization of capital structure of the private entity (Capital structure optimization (CSO model)) according to the algorithm provided in Appendix 16.

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the appropriate services, i.e. invest into infrastructure of municipality, which is not included in the model of CP.

5.1. Input data: E_{min}, $IRRE_{min}$, $DSCR_{min}$, profit tax, r_{pr}, r_{pu}.
5.2. Let i = 1 and $E_i = E_{min}$, which represent a minimum share of equity in the capital.
5.3. Calculation of E_i, D_i, $IRRE_i$, $DSCR_i$, SFA_i.
5.4. Evaluation whether E = 100%. If yes, go to step 5.5, otherwise go to step 5.6.
5.5. $E_{i+1}=E_i + 1\%$ and go to step 5.3.
5.6. Selection of all iterations, where $DSCR_i \geq DSCR_{min}$; $IRRE_i \geq IRRE_{min}$; $SFA_i \geq SFA_{min}$. Evaluation whether there are any iterations satisfying the criteria. If yes, go to step 5.7, otherwise increase by minimum financial support from the public sector (grants, subsidies, guarantees, etc.) and go back to step 5.2.
5.7. Finding of E, where E = min(IRRE).
5.8. Addition of the retained risks, calculated in step 3.4 of stage 3 and go to step 8.
6. Analysis of the contractual PPP according to the algorithm provided in Appendix 17.
6.1. Decision whether revenues from direct users can be collected. If no, develop a social-based SB model and go to step 6.2., otherwise go to step 7.
6.2. Depending on the determined scope of PPP, as it has been done in step 1 of stage 3, identification of whether investment is needed. If no, develop the SB based on the "Management" or "Operate and management" form of PPP and go to step 6.3, otherwise go to step 6.7.
6.3. Optimization of capital structure as explained in step 5 (CSO model) and graphically shown in Appendix 16.
6.4. Evaluation of costs that are expected to be experienced by the PPA in the PPP.
6.5. Addition of the retained risks, calculated in step 3.4 of stage 3.
6.6. Evaluation whether the SB is viable and affordable. If yes, go to step 8, otherwise go to step 11.
6.7. Development of the SB based on a combinative scheme of tasks: design, build, rehabilitate, operate, maintain, etc. where "PFI" is prevailing.
6.8. Optimization of capital structure as explained in step 5 (CSO model) and graphically shown in Appendix 16.
6.9. Evaluation of costs that are expected to be experienced by the PPA in the PPP.
6.10. Addition of the retained risks, calculated in step 3.4 of stage 3.
6.11. Evaluation whether the SB is viable and affordable. If yes, go to step 8, otherwise go to step 6.12.
6.12. Evaluation the possibility to collect revenue from direct users. If this is accepted, go to step 7.2, otherwise go to step 11.
7. Development of the economic-based SB model.
7.1. Depending on the determined scope of PPP, as it has been done in step 1 of stage 3, identification of whether investments are needed. If yes, go to step 7.2, otherwise go to step 7.9.

7.2. Development of the SB based on a combinative scheme of tasks: design, build, rehabilitate, operate, maintain, etc. where "Concession" is prevailing.
7.3. Optimization of capital structure as explained in step 5 (CSO model) and graphically shown in Appendix 16.
7.4. Calculation of costs that are expected to be experienced by the PPA in the PPP.
7.5. Addition of the retained risks, calculated in step 3.4 of stage 3.
7.6. Evaluation of whether the SB is viable and affordable. If yes, go to step 8, otherwise go to step 7.7.
7.7. Evaluation of whether it is possible to extend the PPP period, i.e. $t_i < t_n$. If yes, go to step 7.8, otherwise go to step 11.
7.8. $T_{i+1}=t_i + 1$. Go back to step 6.
7.9. Development of the SB based on the "Management" or "Leasing" form of PPP contract.
7.10. Optimization of capital structure as explained in step 5 (CSO model) and graphically shown in the Appendix 16.
7.11. Calculation of costs that are expected to be experienced by the PPA in the PPP.
7.12. Addition of the retained risks calculated in step 3.4 of stage 3.
7.13. Evaluation of whether the SB is viable and affordable. If yes, go to step 8, otherwise go to step 11.
8. Assessment of whether the quantitative VfM is positive. If yes, go to step 12, otherwise go to step 9.
9. Assessment of non-valued effects, if the appropriate approach is applied.
9.1. Identification of relevant criteria.
9.2. Assignment of weights to criteria.
9.3. Calculation of full scores of both the PSC and the SB model, based on the framework presented in Table 2.6.
10. Calculation of VfM, based on quantitative and qualitative assessment. Evaluation of whether VfM is positive. If yes, go to step 12, otherwise go to step 11.
11. Implementation of IP in a conventional way.
12. Definition of conditions of PPP to the private entity in the RFP and launch the procurement of the PPP.

The results of stage 3 allow stating that this stage is the most complex; however, it is also the most productive in terms of outputs related to the assessment of PPP's possibilities to optimize investments in public infrastructure. It allows developing both the rational-to-compare public sector option of IP implementation as well as the private bid which is the most expected to be proposed from the private sector. The viability and affordability of PPP is also assessed, which allows the PPA to evaluate the reality of possibilities to implement an IP as a PPP. These results allow determining the appropriate conditions of collaboration to the private entities. The calculation of $FOPS_{max}$, $FOPS_{rtn}$, and MP_{pr} allows the PPA to form negotiating positions.

Stage 4: VfM assessment of the actual bids. When the PPA gets the actual bids, it is relevant to assess whether they are still VfM, since they, as explained in Section 2.1.5., can significantly differ from what has been analyzed by the PPA in respect of demand prognosis, risk assessment, elements which have to be included in the IP or, due to errors, done by the PPA. Therefore, as shown in Figure 2.17, the PPA, depending on the results received from the market, has to accomplish the following steps according to the algorithm presented below.

1. Checking whether the actual bids significantly differ in terms of main assumptions from the PSC developed by the PPA before launching the PPP procurement. If yes, go to step 2, otherwise go to step 3.
2. Correcting the PSC according to the assumptions of the preferred bid to ensure competition on the same level playing field.
3. Comparing the PSC with the PPP after negotiation with the private entity, as described in steps 9–12 of stage 3. Evaluate whether the PPP is VfM. If yes, sign the PPP agreement with the preferred bidders and do financial closure, otherwise go to step 4.
4. Implementation of the IP in a traditional way.

This stage allows the PPA to evaluate how its assumptions regarding the private sector's efficiency and innovation match the actual bids proposed by the market as well as assess whether in the specific case the PPP is VfM. The proposed model allows determining which criteria have been decisive in making a decision for IP implementation as the PPP.

Stage 5: VfM monitoring. In summary of Section 2.1.5., the quality of results of the assessment of PPP's possibilities to optimize investments in public infrastructure, especially before making a decision for launching PPP procurement, highly depends on the assumptions applied in the development of both the PSC and the SB as well as their comparison. Therefore, since the PPP is established, it is important to collect information from actual experience of PPP implementation which could be systemized and applied to other consideration for PPP implementation. This stage is also important for the purpose of monitoring the activity of the private entity within the requirements defined in the PPP agreement.

The features of the above-proposed model allow summarizing that an accomplishment of all stages allows the PPA to not only assess the possibilities of PPP to optimize investments in public infrastructure, but also 1) to develop an IP which could provide the best available socio-economic benefits to the society, 2) to select IPs emphasized by the highest PPP potential and use public funds rationally for its assessment for implementation as the PPP, 3) to develop a rational-to-compare option of the public sector as well as the option expected to be proposed by the private sector, 4) to assess the viability and affordability of PPP, 5) to make corrections which allow achieving the best available VfM for the public sector, and other things that, in turn, make the very assessment rational and the results viable to be implemented in practice.

Summarizing the theoretical solutions and the model provided in this part of the dissertation, the assessment of PPP's possibilities to optimize investment in public infrastructure is a set of various steps needed to be coherently accomplished, from

the identification of the appropriate problem by developing the initial IP to multicriteria analysis for possibilities of the private sector to increase benefits to the public sector in respect of cost efficiency, innovation, NFBs and non-valued affects. It covers many quantitative and qualitative aspects that make it complex in nature. While the reliability of assessment results highly depends on the validity of assumptions applied in developing both the PSC and the SB options as well as the very comparison of these options, i.e. like-for-like comparison. Considering the issue of complexity, an algorithm is developed which systemizes the assessment process and enables the PPA to evaluate benefits rising from the participation of the private sector in the provision of public infrastructure and services and to maximize this benefit. Regarding the difficulties to apply reliable assumptions, the author of this dissertation suggests the appropriate approaches and provides the possible solutions; however, he also leaves the PPA with possibilities to apply its own assumptions in respect of FDR, PDs, risk sharing and allocation, selection of PPP forms, etc., which makes the model flexible to the PPA's requirements. Therefore, although the developed model is proposed within the assumptions, it is designed to be applied in Lithuania – some of its elements are already applied in practice. such as, e.g., from 2015 the PDs are used to assess risk in all EU-funded IPs or from 2017 to calculate $FOPS_{max}$, $FOPS_{rtn}$, MP_{pr} – it can also be applied to solve the same issues of evaluating PPP's benefits in other countries. These examples of its elements practical application allow to argue that the proposed model has a great potential to be applied as a tool allowing governments to develop an entire framework of assessment of IPs to be implemented as the PPPs, where the applied structured process of assessment and decision-making regarding PPP implementation would provide more trust on government's actions as well as makes the process of assessment more transparent itself. Considering these ambitions, the validity of this model to use in practice is analyzed in the following part of this dissertation.

3. VERIFICATION OF THE MODEL FOR ASSESSING THE POSSIBILITIES OF PPP TO OPTIMIZE INVESTMENTS IN PUBLIC INFRASTRUCTURE

To verify the suitability of the created model to be applied in solving the research problem on how to assess the possibilities provided by the PPP to optimize investments in public infrastructure, an empirical research based on the case study has been performed. Accordingly, this part of the dissertation is devoted to the analysis of possibilities to implement the hypothetical IP as a PPP under various simulated scenarios. However, since the developed model, in its nature, is highly sensitive to the applied values of FDR and risk estimates, as disclosed in Section 1.3.1., the beginning of the research is committed to determining the specific FDRs, as one of the general assumptions applied in VfM assessment, and the assessment of impact of the applied empirically-grounded PDs on contingent liabilities of the public sector of Lithuania related to the implementation of public investments in infrastructure. Regarding this logic structure, this part of dissertation consists of the following major sections: the first presents and discusses the results of FDRs' calculation as well as discloses the effect of the above-mentioned PDs on values of investment cost overrun risk, while the second describes the hypothetical IP and, by applying the developed model, analyzes its possibilities to be implemented as the PPP.

3.1. Determination of the main general assumptions used in the model

To be prepared for the assessment of the empirical verification to solve the research problem, the developed model, among the other aspects, requires adopting the assumptions related to the determination of FDR and the application of PDs. Considering the developed methodology, this section provides the results of FDR calculation and the effects of the empirically-grounded PDs on values of Risk.

3.1.1. Determination of individual FDRs of the member states of the EU

To disclose the features of the model allowing the government to determine the suitable FDR for discounting CFs of the IPs and, to facilitate its application in practice, individual FDRs for each of the member states of the EU have been calculated. Considering the model, FDRs are calculated by using two methods.

Calculation of FDRs by using the long-term borrowing rate approach

To calculate FDRs based on the long-term borrowing approach, monthly data of 10-years sovereign bond yields in the period 2007–2016 have been used and the averages have been calculated for each of 27 EU countries[54]. Figure 3.1 shows the results of calculations.

The results have disclosed that the average borrowing rates are very different among the countries with the ratio between minimum and maximum values equal to nearly 4.5. These differences are determined by a complex of various factors, such

[54] The exception is Estonia, which has not issued its 10-year bonds, therefore this approach is not suitable to be applied for calculation of the FDR in a case of this country.

as government debt level, credit rating, etc., considering which the lenders have required the appropriate compensation for risk borne for lending money. Here it is important to consider that the analyzed data cover a period which is emphasized by the rapid economic growth in the beginning, the debt crisis in the middle and the record low interest rate environment in the end. Therefore, the average values are affected by significant market volatility as the results of standard deviations' calculation show. Relatively the highest FDRs have been determined in countries such as Cyprus, Portugal, Hungary, Romania and Greece ahead, which were unable or struggled to repay their government debt. However, most countries attributed to the developed one emphasized by lower FDRs.

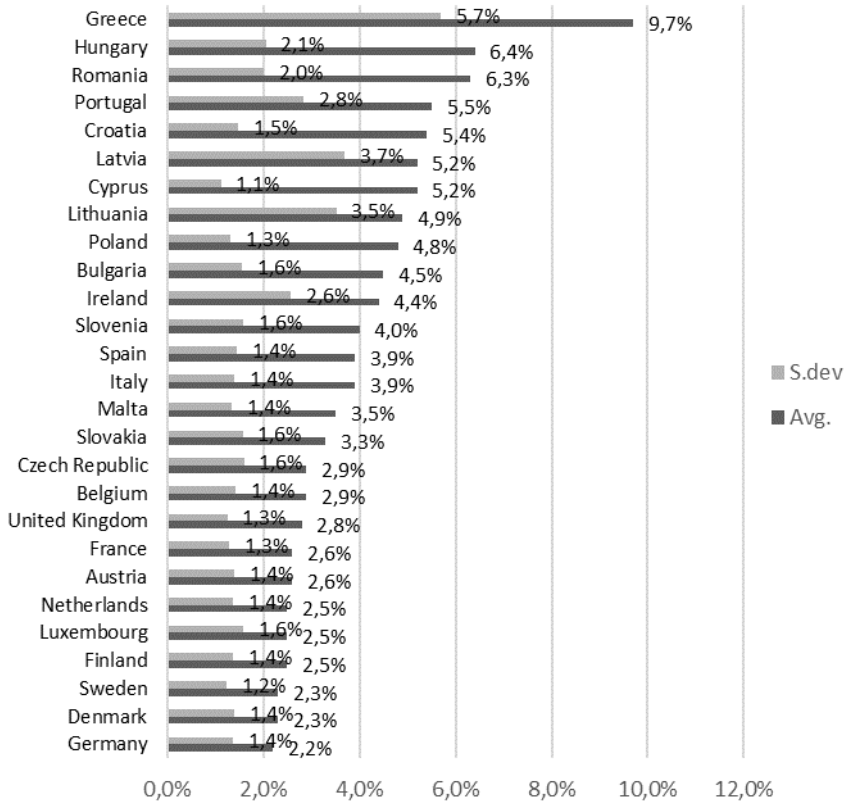

Figure 3.1. FDRs of the EU countries (the long-term borrowing approach) (prepared by the author of this dissertation)

Regarding the EU regulation (European Commission, 2014a), a 4% FDR has to be applied as an indicative benchmark for public investment operations co-financed by the ESI Funds. However, as the results show, only the individual FDR of Slovenia was equal to this benchmark. Nearly half of the analyzed countries are marked by lower FDRs. This disclosed that the application of individual FDRs in them would result in higher a return ratio expressed in net present values. On the other hand, the application of FDR determined by the Commission in the remaining

countries, among which there is also Lithuania, would result in an overestimation of return indicators, since it actually does not reflect the real situation and is too high.

Calculation of FDRs by using the CAPM-based approach

To calculate FDRs under the CAPM-based approach, Formulas 5 and 6 have been used, accordingly. Given the fact that the developed formulas are applied to the emerging (also frontier) and developed countries, respectively, the classification of the countries was based on the MSCI Country classification standard (MSCI, 2014). The risk-free rate was equated to US 10-y bond yields (monthly data), the S&P 100 Global index (10-y monthly return rates) was chosen to calculate r_g and σ_g. Average return rates of the local markets have been calculated by using data of national security market indices. The longest accessible data covering the period of 2007–2016 was used. R_c was determined by using the data of rating-based default spreads provided in the Damodoran website (Damodaran, 2017). Detailed results of FDR calculation are provided in Appendix 18. Meanwhile, Figure 3.2 and Figure 3.3 show the results of FDR calculation based on the CAPM approach in the developed and emerging countries, respectively.

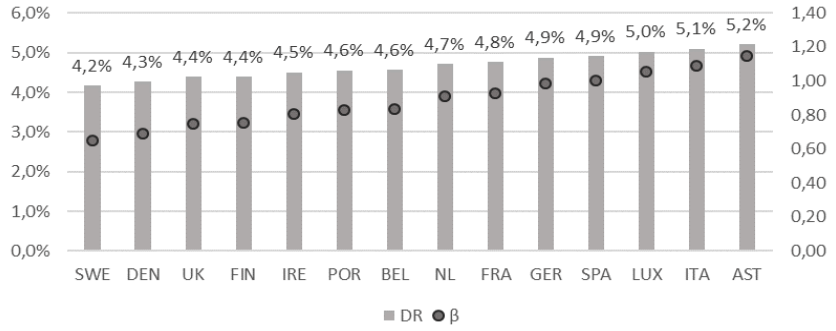

Figure 3.2. FDRs of the developed countries (CAPM-based approach) (prepared by the author of this dissertation)

In the group of the developed countries, the distance between the marginal values of FDRs is relatively narrow, i.e. 1% point with the lowest FDR in Sweden and the highest in Austria. Since, considering Formula 6, there is no additional risk premiums included in the assessment, the beta coefficient is a determinant factor for the results obtained. The lower is the correlation and difference between the returns on local and global security market indices, the lower is beta. Scandinavian countries, which have survived the 2009–2012 financial crisis relatively easier, have been considered as a lower risk area for investments resulting in the lowest betas and, herewith, FDRs in such countries as Denmark, Finland and Sweden. While, Germany, Spain, Luxembourg, Italy and Austria have got into the group of countries emphasized by betas higher than 1, which discloses their security markets being riskier than the systemic risk. Among the countries with one of the highest FDRs there are also such countries as Italy and Spain, which have suffered form debt crisis and owed massive debt to the European Central Bank (ECB), which, in turn, at least partly allows explaining their higher FDRs.

The results in the group of emerging and frontier countries shows that, in general, FDRs in these countries are higher than in the developed ones. This mostly can be explained not by the values of betas, which tend to be very diverse among these countries, and additional risk premiums, R_c, calculations of which are based on rating-based default spread. This determines that Greece and Cyprus, which were unable to repay or refinance their government debt and, therefore, were bailed out through the assistance of third parties including the Eurozone countries, the ECB, and the International Monetary Fund, are distinguished by the highest FDRs.

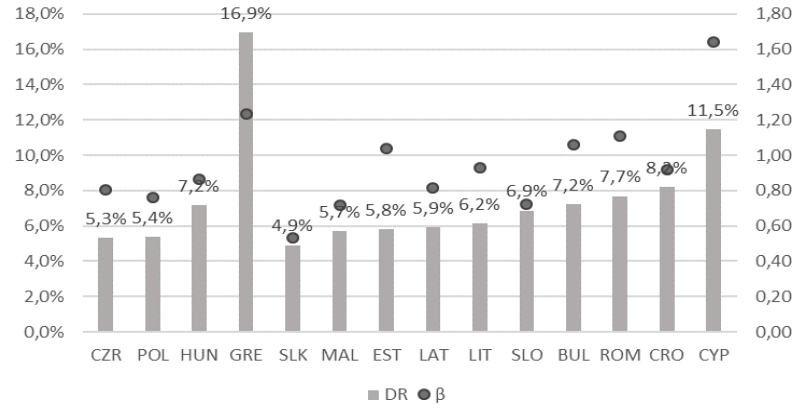

Figure 3.3. FDRs of the emerging and frontier countries (CAPM-based approach) (prepared by the author of this dissertation)

To compare the values of FDRs, Figure 3.4 presents the differences between the values of FDRs calculated under both of the above-presented approaches. The results show that countries such as Ireland, Hungary, Poland, Latvia and Romania, the difference in values between different approaches is relatively low, i.e. less than 1% point. Therefore, the choice of the appropriate approach for FDR calculation has relatively little effect on NPVs used as measures for assessing PPP's possibilities to optimize investments in public infrastructure. However, the analysis disclosed that FDRs calculated under CAPM-based approach is by on average 2.1 percent point higher than calculated under the long-term borrowing approach. This can be considered as a significant difference, since it has to be taken into account that in the PPP the FDR is usually used for discounting of CFs in the period of 20–30 years. In the same problematic countries such as Cyprus and Greece this difference exceeds 6% and 7% points, respectively. This discloses that the application of CAPM-based approach would have significant effect on NPV of PPP's costs when they are experienced as the unitary payments.

In the case of Lithuania, the distance between the FDRs calculated under different approaches is equal to 1.3% point, which is lower than the estimated average difference. This determines that despite the approach is chosen, the results of quantitative VfM assessment are similar and there is a little chance of FDR being a critical factor for decision making for IP's implementation as the PPP.

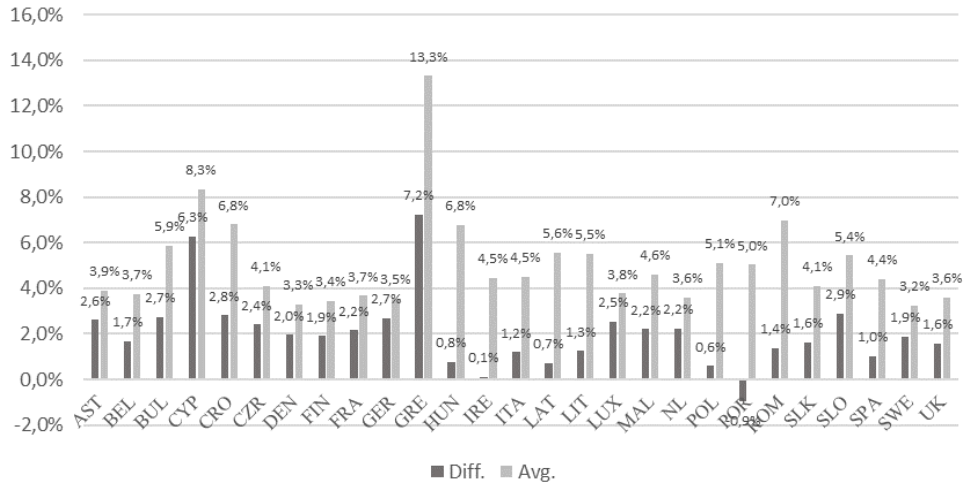

Figure 3.4. Differences among countries' FDRs calculated on the CAPM-based approach and the long-term borrowing approach (CAPM-based approach) (prepared by the author of this dissertation)

However, regarding the recommendation provided in section 2.1.1 related to the choice of an appropriate approach for discounting, the author of this dissertation suggests that, despite which of methods, NPM or the traditional one, is more prevailing in managing investments in the public sector, it is relevant to assess the benefits of IP implementation as a PPP by applying several different FDRs, whose marginal values represent the above-mentioned approaches, to evaluate whether the application of FDR determine different outcome regarding the choice of the optimal way to proceed the IP. If the FDR of an appropriate level becomes a critical factor determining whether to go into the PPP, the weight of qualitative assessment's results should be increased by making the decision for the optimal way of investment implementation.

3.1.2. Assessment of impact of the empirically-grounded PDs' application on cost overrun risk estimates

In the paper prepared by the author of this dissertation (Jasiukevicius & Vasiliauskaite, 2015a), empirically-grounded PDs and their parameters which best enable to assess the Risk in public IPs were provided. From the beginning of 2015, they have been officially applied for Risk assessment in the public sector of Lithuania as well as for the development of the former Risk assessment methodology (CPVA, 2014), theretofore based solely on theoretical assumptions. This resulted in changes of the estimated values of not only Risk estimates, but also the related contingent liabilities (CLs) of the public sector. This section of the dissertation is committed to provide the summarized results of the research done by the author of this dissertation (Jasiukevicius & Vasiliauskaite, 2015b), where the impact of the empirically-grounded PDs' application on the values of the CLs previously estimated under the theoretical assumptions was assessed.

The research was based on a comparative analysis of both theoretically-based and empirically-grounded Risk estimates calculated at the confidence level of 70%. The empirically-grounded PDs and their parameters have been presented in Section 2.1.1. (Table 2.2.), while the theoretical Risk estimates have been calculated based on the PDs and their parameters provided in the methodology of IP preparation developed by CPVA (2013).

Table 3.1 shows a comparison of Risk estimates' results. They disclosed the former values of Risk estimates of land, real estate, construction and equipment as being lower, and the estimates of various services related to investments as being higher in comparison with the empirically-grounded values. Accordingly, this revealed over- and underestimation of appropriate ICOR-related CLs prevailed in the past.

The overestimation of Risk estimates in 5 out of 7 investment groups allows arguing about the general tendency of the actual ICOR borne by the public sector being lower than it has been assumed previously. This disclosed that lower amounts of financing are actually needed to be potentially secured by the government of Lithuania to cover the Risk-related CLs. Depending on the group of investments, the actual Risk financing is lower by from a little bit less than 1/6 in cases of land and real estate to nearly 1/3 in cases of equipment and machineries in comparison with the values estimated under the theoretical basis. The only exception for general tendency is that the Risk estimates related to investments of various services, the empirically-grounded values of which are higher more than twice than it has been assumed. This revealed a significant underestimation of Risk estimates related to these investments as well as disclosed higher financing needed to cover the CLs related to these groups of investments.

Table 3.1. The comparison of ICOR estimates (Jasiukevicius & Vasiliauskaite, 2015b)

Gr	Cash flow of investments	Risk estimates*		Diff., %
		Based on the theoretical approach (1)	Empirically grounded (2)	(2 - 1) / 1
A1	Land	0,400	0,291	-27,40
A2	Real estate	0,400	0,291	-27,40
A3	Construction, major and other repairs	0,426	0,345	-18,92
A4	Equipment and machineries and other assets	0,262	0,178	-31,97
A5	Projection, technical maintenance and other services related with investment into A1-A4, (A5 and A7)	0,131	0,308	135,20
A6	Reinvestments (A3 and A4)	0,426	0,290	-31,96
A7	Other services	0,131	0,265	102,15

* - at a confidence level of 70%

Since there are no arguments provided regarding the reasoning of theoretical assumptions used to calculate the theoretically-based Risk estimates, the author of this dissertation does not go into the discussion of possible explanation and confines in the comparative analysis instead.

However, for the evaluation of practical benefits related to the application of the empirically-grounded PDs the results allow arguing that, regarding groups A3 and A4 of investments to which the most of investments are implemented, the empirically-grounded Risk estimates are on average lower by a quarter in comparison with the previously calculated ones, i.e. with every million euro of investments the actual risk estimates are lower by 82.2 thousand euro. Considering the amount of ESI funds foreseen to the public sector of Lithuania in the programing period of 2014–2020, which is little bit more than 5 billion euro, the CFs related to ICOR is lower than 413 million euro. Accordingly, this amount of financial resources can be potentially used for the implementation of other IPs.

Since both the determination of the FDR and application of the proper PDs are based on the empirical research, they, as empirically substantiated assumptions, are included as the default variables in the developed model, the verification of which to be applied for the evaluation of possibilities provided by the PPP to optimize investments in public infrastructure is carried out in the following section.

3.2. Verification of the model for assessing the possibilities of PPP optimize investments public infrastructure: a case study

To accomplish the aim of the research and this dissertation, this section is designed to demonstrate the possibilities of the developed model to be applied in practice and verify its suitability to solve problems raised in the dissertation, i.e. how to evaluate the possibilities provided by the PPP to optimize investments in public infrastructure that the results obtained would enable to make reasonable decisions for the most efficient ways of their implementation. The section consists of two the main parts: the first part describes the hypothetical IP used for the verification of the model; the second part simulates the developed model under various the hypothetical IP-based scenarios to verify its suitability to be applied in practice for solving the above-mentioned problem.

3.2.1. Description of the hypothetical project

To demonstrate the possibilities of the developed model to be applied as a practical tool for the evaluation of possibilities provided by the PPP to optimize investments in public infrastructure, a hypothetical IP covering the development of parking infrastructure and delivery of services was developed. In general, there are many economic sectors where the PPP, can be applied as an alternative way of public procurement and the developed model could be tested. However, the reason of choosing this type of IP is that the services of parking infrastructure, as a financial structure, in principle can be very flexible in respect of financial mechanism and risk allocation and therefore it allows simulating many different scenarios making it as one of the most suitable case studies to verify the suitability of the developed model to solve the issues analyzed in this dissertation.

As a business, the operation and management of parking infrastructure, especially in the case of developing new multi-storey parking lots, requires the appropriate special technical expertise and know-how, in addition to large capital

availability depending on the capacity which is needed to ensure. Therefore, the assurance of sufficient parking infrastructure availability next to, e.g., planned to expand public facilities such as hospitals, airports, stations, etc. can be a significant challenge which is often tried to overcome by involving the private sector in a long-term relationship. Accordingly, such IPs are mainly implemented by the private promoters who can ensure capital financing and provide sufficient know-how needed to develop and operate the parking infrastructure in the most efficient way. The particularity of parking lot operation and management is that, due to the current development of technologies such as automatic number plate recognition systems, parking guidance systems, electronic payment systems, etc., it requires relatively low human workforce, since most operational processes can be fully automated. This determines that operation costs mostly consist of electricity, maintenance and repair and cleaning costs, and the operation costs of parking lots are usually covered by payments from direct users. They are charged tariffs which are regulated by the government. However, there are also cases where parking services are partly subsidized by the government or are free of charge, depending on their purpose and integration into public services. For example, a staff of a public facility to which the parking infrastructure is built usually has a significant discount for long-term parking. This determines that a part of investment and operation costs has to be funded from the public budget, since they are not fully covered by the revenues from direct users. Accordingly, various combinations of charging the users and financing needed from the budget determine the existence of various potential financial structures of IP with inherited the potential risks of revenue stream and further possibilities to allocate/share them between the public and private parties in case it is implemented as a PPP. Considering this particularity, here the demand risk can be argued as the most important. It can assert due to such factors as lower than the expected capacity of the main public services or/and a rise of new competitive infrastructure which determines a decrease of traffic flow to the parking infrastructure and thus the revenue stream to cover all costs. Figure 3.5 summarizes the cash-flow critical variable.

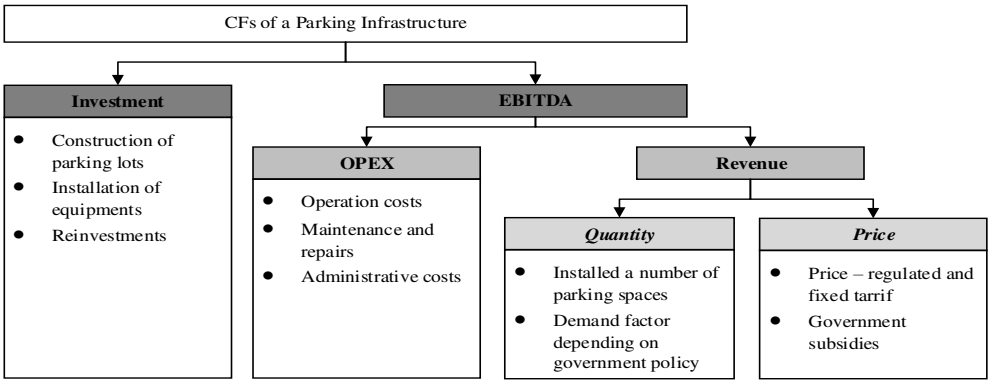

Figure 3.5. Critical variables of a parking infrastructure IP (prepared by the author of this dissertation)

Considering the above-described particularity of the sector, a hypothetical IP was developed under such circumstances and with the following characteristics.

Description of the hypothetical IP

Considering the identified shortage of parking infrastructure near a rapidly growing institution of public services' delivery, let's say, in this case, an airport, however, this can also be a bus station, railway station, etc., there is a determined need to ensure the availability of 2400 new additional parking spaces (PaSs) to satisfy the expected demand in the upcoming years. To fill the gap of infrastructure, it is planned to build new and renew the current parking lots in which the total capacity of 3000 PaSs will be ensured.

Figure 3.6 illustrates the infrastructure development plan of the hypothetical IP, where P1 and P2 are the renewed current ground parking lots and P3 are two newly-built multi-storey parking lots, respectively. Considering the rational use of infrastructure, parking lot P1, since it is near the main building of public services' delivery, is dedicated to short-term parking. Parking lot P2 is mainly used as the pick-up and drop-off point. While P3 parking lots, which are planned to be built away from the main building, are foreseen for long-term parking.

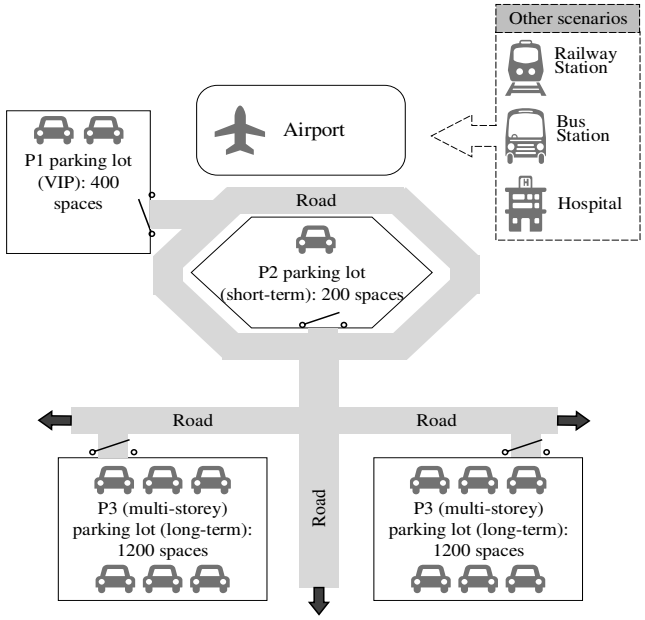

Figure 3.6. The hypothetical IP: parking infrastructure (prepared by the author of this dissertation)

To implement the IP, the tasks of design, construction (build), operation and maintenance of parking infrastructure have to be accomplished. Table 3.2 presents the key input variables used to prepare the IP (all inputs are provided in Appendix 19).

Table 3.2. Key input variables of the hypothetical IP (prepared by the author of this dissertation)

Economic data	
2%	Inflation rate for everything except expense of energy, water and waste disposal
3%	Inflation rate for expense of energy, water and waste disposal
Taxes	
21%	VAT
15%	Profit tax
Project schedule	
25	Reference period for CFs calculation (number of years)
150	Days needed to complete the design
360	Days needed to complete the garage (per contract)
91	Days needed to install the equipment (per contract)
8 621	Total days in the operation period
13	Year at which medium repair is needed
21	Year at which major repair is needed
Investments	
2 400	Number of parking spaces built in the multi-storey parking facility
600	Number of parking spaces built in the ground parking facility
150 000	Total design costs (€)
20 157 600	Total investment costs (€) into the parking garage
151 697	Total investment costs (€) into the parking equipment
Amortization and depreciation	
15	Depreciation period of garage infrastructure (year)
5	Depreciation period of parking equipment infrastructure (year)
Operation costs	
512 849	Annual operation costs
360 000	Cost of medium repair
1 050 000	Cost of major repair
Revenue	
1 003 206	Annual P1 parking revenue (€)
253 652	Annual P2 parking revenue (€)
2 174 976	Annual P3 parking revenue (€)
Loans	
10	Term of permanent loan (years)
3.0%	Interest rate on loan during the construction period
2.5%	Interest rate on loan (post construction)

Assumptions used in the IP cover the period of 25 years, which is divided into the construction and operation periods. The construction period includes the tasks of developing design, building and renewal of parking lots and installation of equipment, which continues for 601 days in total, i. e. 20 months. The rest of the reference period, which starts immediately after the completion of infrastructure, is left for the tasks of operation and maintenance of infrastructure. Accordingly, annual operation costs as well as maintenance and reinvestments costs starting from the beginning of the operation period are regularly included in the schedule of the IP. The revenues are also allowed to be collected only when all constructions and installations are completed.

To manage the demand of this infrastructure efficiently, the following assumptions for the appropriate parking pricing was determined. Table 3.3 shows that hourly price of the short-term parking lots is more expensive than the long-term parking, especially in the case of the parking lot (P2), which is mainly devoted to

short pick-ups and drop-offs. Here the assumption is made that every hour of parking is charged an hourly rate until the accumulated equal to the daily rate is reached. Considering the purpose of parking lot P2, the first 15 minutes are free of charge. Daily revenues are calculated considering different loads of infrastructure during a 24-hour period. Three picks of demand in morning, afternoon and evening are included in the assumptions, accordingly. It is assumed that 5% to 65% of PaSs, depending on the parking lot, are used for daily parking, while the rest of PaSs are occupied on average from 10% to 44% by hourly parking, respectively.

Table 3.3. Pricing of parking infrastructure (VAT included) (prepared by the author of this dissertation)

Pricing	P1	P2*	P3
Hourly-parking	1,03	1,45	0,83
Day-parking	7,19	7,19	2,52

*First 15 min. is free of charge (once a day)

It is also assumed that capital investments are partly financed by loans. Loan, the duration of which is 10 years, is repaid by using a linear amortization schedule. The loan is capitalized until it starts to be repaid from the beginning of the operation period.

Using the above-presented and other key input variables provided in Appendix 19, the hypothetical IP will be developed and simulated under various conditions, in which it is possible to be implemented as the PPP will be assessed and, herewith, the suitability of the developed model to be applied for solving the issues raised in this dissertation will be demonstrated.

3.2.2. Assessment of PPP's possibilities to optimize investments in public infrastructure

To verify the possibilities of the developed model to be applied in solving the practical issues of assessing the possibilities provided by the PPP to optimize investments in public infrastructure, a hypothetical IP, as a case study, the key input variables of which have been presented in the previous section, is used. Accordingly, it goes through the stages of assessment. However, since the developed model covers ex-ante assessment (stages1–3), actual assessment (stage4) and ex-post assessment (stage5), only the first three stages have been included in the case study. To accomplish stage 4, actual proposals are required. While stage 5 can be performed only when the PPP IP is implemented. Therefore, considering the feature of the model that stages 4 and 5 are mainly a repetition of the steps included in stage 3 with the exception that data of actual IPs are used, this case study is focused on the ex-ante assessment, i.e. the assessment of *possibilities* provided by the PPP to optimize investments in public infrastructure and the results are used for making decision for an efficient way of IP implementation. Moreover, since the whole dissertation, beside all factors needed to be considered, is focused on the calculation elements and the financial aspects, more specifically, to make the assessment of the model more constructive, the following preconceived assumptions were made:

- The problem formulated in the hypothetical IP: "*shortage of infrastructure to satisfy a need of PaSs*" is grounded in the analysis where a gap between long-term demand and supply of the parking service has been determined;
- There is requirement of 2 400 new PaSs and the infrastructure of total capacity of 3 000 PaSs.
- The option of building 2 400 new PaSs and renewing 600 PaSs is assessed among other options as providing the highest socio-economic benefit ($EGDV_{max} > 0$), therefore, chosen for assessment of its possibilities to be implemented as the PPP.
- The scope of the IP is equal to the scope of the PPP IP.
- For discounting of CFs, the NPM approach is applied, therefore, the CAPM-based FDR equal to 6.2% (the case of Lithuania), which has been calculated in Section 3.1.1., is used.
- The assessment is performed considering the taxation policy in Lithuania.

To reveal the practical possibilities of the developed model to be used under various conditions beside the above-presented assumptions, the case study is divided into two basic scenarios. The main difference between them is based on different risk allocation between the public and private entities, since, as disclosed in Section 1.2.2., it is one of the most important factors determining which of the forms would be the most suitable to implement the IP as the PPP. More specifically, the difference reveals in demand risk. In the first scenario, which represents *the economic-based PPP model*, most of demand risk is assumed by the private entity, which is rewarded the right to collect revenues from direct users. While in the second scenario, which represents *the social-based PPP model*, all demand risk is assumed by the PPA, which pays the private entity for infrastructure availability (availability fees), while services are free of charge to the direct users.

3.2.2.1. Economic-based PPP model

Stage 1. Preparatory conditions. According to the developed model, to assess the possibilities provided by the PPP to optimize investments in public infrastructure, primarily there is a need to construct the CP option, which would be rational to compare against any other option with the appropriate involvement of private participation. This requires preparing the IP, whose detailed schedule and the main annual CFs: investments, depreciation, O&M, revenues, financing, etc., considering the key input variables of the hypothetical IP, are provided for the period of 25 years in Appendix 20, where the summarized statement of total revenues and costs also can be found.

Figure 3.7 shows returns on investments depending on the length of the IP period. If the IP, considering the assumptions made and the time VfM, were implemented in the traditional way, the payback period required to recover investments would be 11 years. This can be considered as a quite long period from the perspective of the private sector, but since the price level is determined at a socially-acceptable level, this can be acceptable for the public sector. The figure

illustrates that the longer reference period, the higher are return indicators, although the marginal growth, due to the value of time, is significantly decreasing in the second half of the period. Since the case of the 25-year period is considered, NPV(I) and IRR(I), the calculation of which is based on Formula 8, are equal to 21m EUR and 15%, respectively.

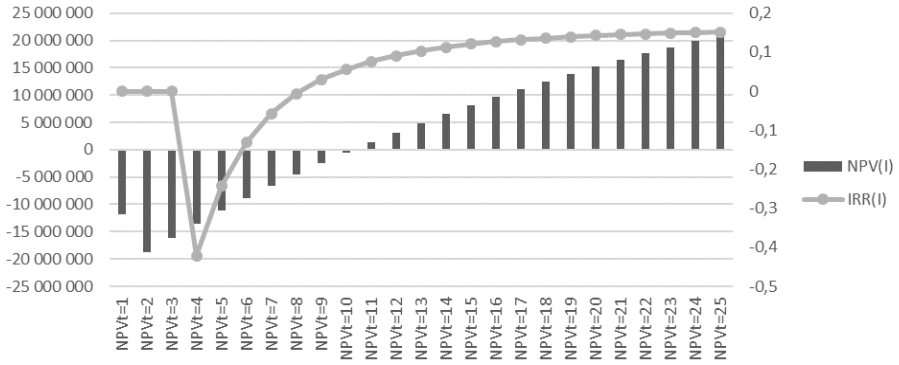

Figure 3.7. Return on investments depending on the length of a period (revenue generated IP) (prepared by the author of this dissertation)

Stage 2. Expediency criteria. Since the initial IP is developed, the second phase is to assess its potential to be implemented as a PPP. Considering the expediency criteria provided in Section 2.1.2., Table 3.4 shows the assessment results where all criteria are satisfied.

Table 3.4. Assessment of the hypothetical IP against the expediency criteria (prepared by the author of this dissertation)

No.	Criteria	Yes/No	Justification
1	Is there a requirement to invest a significant amount in the infrastructure?	Yes	21,3m EUR investments
2	Is there long-term demand for infrastructure and service planned to deliver in the PPP?	Yes	25 years
3	Is it possible to expect benefits from an integration of tasks of infrastructure development and service delivery?	Yes	Integration of design, construction, O&M tasks
4	Can the outputs of service performance be clearly measured?	Yes	Output specifications can be easily determined
5	Is it possible to share and allocate risks between the public and private sectors?	Yes	Most risks can be transferred to the private sector
6	Can the revenue stream to the private entity be clearly identified?	Yes	Direct user payments
7	Is there any interest in the IP from the private market?	Yes	Market research revealed the existence of interest from the private sector as well as sufficient competition in the market

Stage 3. PSC. Since the assessment of the IP against the expediency criteria was positive for the further analysis of PPP's possibilities to optimize investments in public infrastructure, the third phase of the model starts with the adjustment of the initial IP by risks, which are added to the costs of initial CFs. Accordingly, the risk

values, which were calculated by applying the empirically-based PDs and their parameters, provided in Section 2.1.1., with the total value of 23,3m EUR expressed at present value in the period of 25 years are provided in Appendix 21.

Then to demonstrate the calculation of retained and transferred risk values, four relevant RFs in each of the RGs have been identified and allocated between the public and private entities by using the models of risk allocation and risk values allocation, which have been provided in Section 2.1.3. The results of allocation of RFs among the public and private entities as well as the calculation of values of retained and transferred risks are provided in Appendix 22. They allow summarizing that, considering the allocation of RFs, the total value of risk equal to 23,3m EUR is shared between the private and public entities by proportion of 86% and 14%, i.e. 20,1m EUR and 3,2m EUR, respectively. As a result, the private entity would have to assume most of the risks.

Figure 3.8 shows the net present values of $FOPS_{max}$, $FOPS_{rtn}$, MP_{pr} and risk values, detailed of which calculation, based on Formulas 10–12 and considering the length of reference period, are provided in Appendix 23. It shows that the longer is the period, the lower financing from the public budget is needed to make the IP financially viable, because there is more time to recover investments and earn the profit from revenues paid by the users of services. However, when the period increases, risk value, including the $FOPS_{rtn}$, also grows significantly, because the longer period is, the higher is uncertainty related to future CFs of the IP. This determines that $FOPS_{max}$, although decreases during the entire period, remains positive, even if CN cost is excluded from the calculation. Accordingly, this allows stating that, within a 70% confidence level, the PPA would have a loss from the implementation of IP. When the period is extended to 25 years, the sum of 5,2m EUR, expressed in present value, is a maximum allowed obligation of the public sector, above which the PPP as a way for delivering infrastructure and services becomes ineffective from the financial point of view to the public sector[55]. The most of this sum consists of risk costs, since the IP is profitable and MP_{pr} is below zero, accordingly. While, the sum of 3,2m EUR is the maximum value of retained risk, which is rational to assume by the public sector in the PPP, considering the risk allocation.

Since the public sector can have an advantage over the private entities in terms of tax payment, the taxes of land rent, asset and monitoring of PPP contract implementation, have been additionally included as NC in this case. In the period of 25 years the sum of NC expressed in present value is equal to 2,9m EUR. Calculation of NC is provided in Appendix 24.

[55] If $FOPS_{max}$ were assessed from the PPA's point of view, it has to be reduced by CFs of taxes which do not come directly as tax revenue to the PPA.

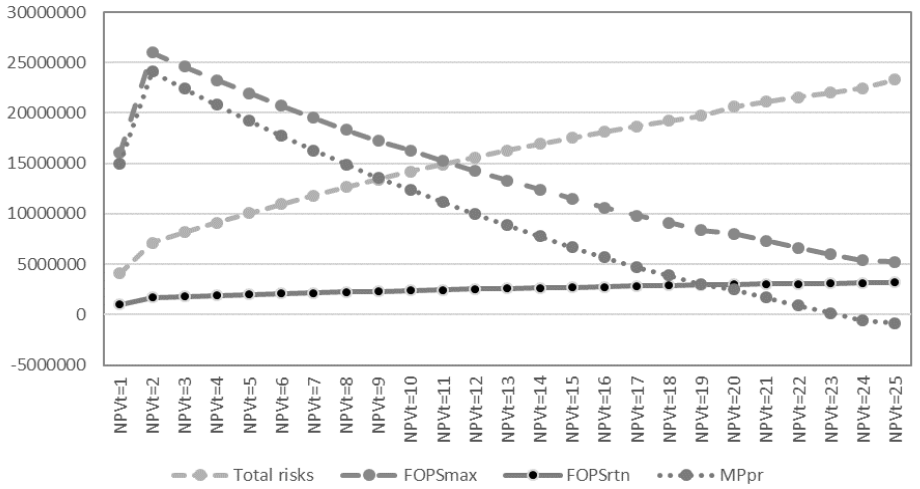

Figure 3.8. $FOPS_{max}$, $FOPS_{rtn}$, MP_{pr}, value of risk depending on the length of a period (revenue generated IP) (prepared by the author of this dissertation)

To develop the PSC, beside the financial aspects, NFBs have also been included in the assessment, since it was assumed that, due to a lack of public budget, the implementation of an IP would be delayed by at least 3 years[56] until the PPA is able to accumulate sufficient resources. The hypothetical analysis of external social-economic impact[57] disclosed that social-economic costs of inaccessibility of infrastructure are at the required capacity is 612k EUR per year or 1 676 EUR per day. The calculation of NFBs is provided in Appendix 24, the results of which allowed summarizing the total value of NFBs expressed in present value which is 1,7m EUR.

Considering the above-calculated elements, the costs of the PSC have been calculated, and their general values and structure are presented in Figure 3.9, while detailed calculations are provided in Appendix 25. The figure shows that, despite the fact if the IP becomes profitable from the 11th year, when the values of risk and CN costs are included in the calculation, the total cost of PSC remains positive through the entire the period of analysis. The line in the figure shows the threshold, above which the PPP does not provide any financial and social-economic benefits assessed in the quantitative assessment, as this case is theoretically explained in Section 2.1.5. In case of the period of 25 years, any obligation of the public sector in the implementation of the IP as the PPP higher than 7,5m EUR within the scope of IP would be considered as an ineffective way to implement. Accordingly, this and other values calculated considering different lengths of period are as benchmarks for further assessment of PPP's possibilities to optimize investments in public infrastructure.

[56] In a real case, the financial affordability analysis has to be done.

[57] External social-economic impact assessment is a part of CBA. Here as one of the best methodologies (CPVA, 2014b) could be applied.

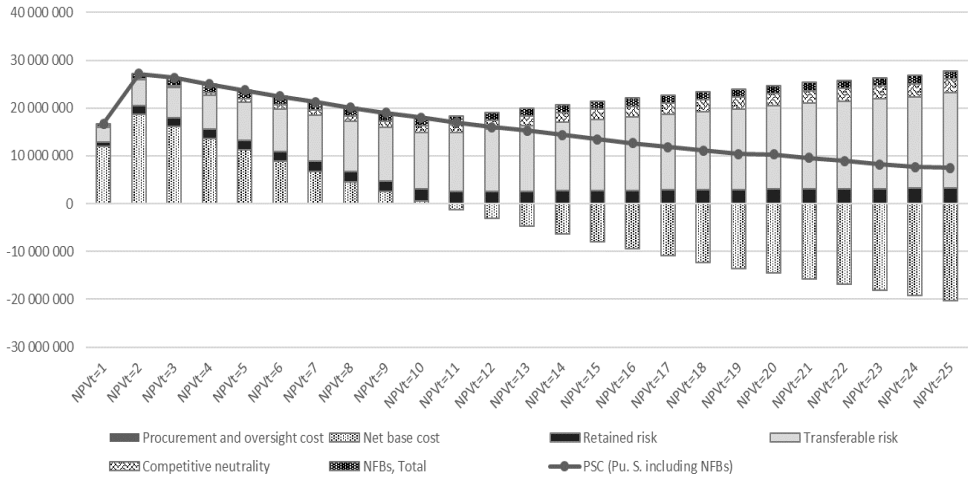

Figure 3.9. The structure of PSC (revenue generating IP) (prepared by the author of this dissertation)

The SB model. According to the developed model, to calculate the obligations of the public sector in the PPP, which could be rationally compared against the PSC, there is a need to prepare the SB IP, characterized by the same scope as in the case of the PSC model; however, taking into account that it has to be implemented by the private sector, i.e. the private entity (or private consortium) under the typical contract of concession has to design, construct, operate and maintain the infrastructure as well as it is awarded to collect revenues from the users for the delivery of services. This requires at least a few additional assumptions. Since it is usually assumed that the private entities (see Section 1.1.1.2.) have higher credit risk than the government, in this case study it is considered that the rate of loan interests is higher in comparison with the pure public option and it is determined to be different in the period of construction, as riskier and, therefore higher, and operation, as relatively less risky and therefore lower, respectively. Moreover, considering the analysis provided in the same section, it was also assumed that 70% of total capital investments are financed by loans[58] and 60% of equity consists of subordinated debts[59]. These and other key input variables related to the implementation of PPP are provided in Appendix 26.

Considering the methodological practice in some countries, cost reduction can also be included in the SB model. This is relevant if there is clear evidence of higher efficiency of the private sector. Let say the statistical data of practically-implemented PPPs discloses that it is possible to expect 10% of total cost savings in the PPP.

Considering the above-mentioned key input variables and assumptions, the sheets of investment, O&M, depreciation, revenues, funding, net operating working

[58] This requires doing loan market research, where the main conditions of loans for the PPP IPs depending on the risk level could be known.
[59] The observed practice in the market.

capital as well as financial statements are provided for the same period of 25 years in Appendix 27. Considering the characteristics of the IP, to make the PPP financially viable, the following requirements from different stakeholders to the IP in the PPP must be satisfied (Table 3.5).

Table 3.5. Requirement for IP in the PPP from the stakeholders (prepared by the author of this dissertation)

IRRE ≥ 12,8 proc.
REPR ≥ 0,3
DSCR ≥ 1,3
LLCR ≥ 1,5
PLCR ≥ 5
SFA ≥ 1
$\sum_{i}^{n}(CI_i - CO_i) \geq 0$

Considering the above-mentioned requirements from the stakeholders, Appendix 28 provides the results of their satisfaction depending on the length of the period. Table 3.6 shows indicators, when CFs of a 25-year period are used. The results show that the SB model under the above-presented conditions is financially viable from the perspectives of all stakeholders, when the period is equal or longer than 8 years. From this duration all indicators become higher than the determined minimum level and are significantly growing as the period increases. On the one hand, this shows the IP as attractive for the market, since it has the potential return higher than it is expected to get from the alternative investment options. On the other hand, this indicates, that any longer than 8-year period determines the expected over profit that is not justified in respect of public interest. Therefore, considering the results of indicators, the period should be shortened to 8 years or assumptions regarding the involvement of the private sector in the provision of public infrastructure and services, which could protect the public interest must be applied.

Since the first option does not require significant changes and the assessment of PPP's possibilities to optimize investments in public infrastructure can be directly transferred to VfM assessment, the second one, to disclose more solutions for the practical issues related to this assessment, is continued in this case study. It is important to set the conditions in the RFP which would not allow giving over a profit to the private entity. If the competition between the investors in the market is high, it is possible to expect a positive effect of market competition, if the price of service and MARF are determined as the competitive criteria to select the most beneficial bid. Depending on the weights on these criteria, the actual bids can be focused on these criteria, therefore the PPA should set them depending on the priorities.

If the PPA seeks to keep the same price level as, e.g., it is determined in the appropriate area, then the strongest competition should be encouraged on MARF, which has to be equal to nearly 0,73m EUR at 40% of revenue sharing level with the PPA (lower than 50% was used considering the recommendation of revenue sharing ratio provided by Yinglin Wang & Liu (2015), to make the SB model financially

viable at the period of 25 years and the risk of over profit would be decreased. If the priority is focused on the price for users, then it is possible to expect 34% decrease of price level[60].

However, if the competition between investors is low, then there is less chance that the market itself will adjust the results of public procurement so that the above-mentioned lower price or higher MARF would be achieved. Therefore, it may be more expedient to set the PPP contract monitoring tax at the level which could allow the PPA to determine conditions for the equity investors acceptable in respect of public interest. Accordingly, the monitoring tax should be increased to 940k EUR, i.e. increased by nearly 20 times.

Table 3.6 shows the results of the above-presented cases of adjustment of conditions to the private entities. The comparative analysis of indicators discloses that stakeholders' requirements are satisfied at similar level in all cases, since it is determined due to the appropriate adjustment of ratios between revenue and cost. However, each of the cases has different VfM that is assessed further.

Table 3.6. The results of satisfaction of stakeholders' requirements in the period of 25 years (revenues generating IP) (prepared by the author of this dissertation)

Indicator	Req.	Eq.	Initial situation	MARF competition	Price competition	Monitoring tax
IRRE	12,80%	≤	34,3%	12,8%	12,8%	12,8%
REPR	0,30	≤	0,3	0,3	0,3	0,3
DSCR	1,30	≤	1,91	1,37	1,37	1,41
LLCR	1,50	≤	6,59	4,58	4,58	4,72
PPCR	5,00	≤	15,22	9,96	9,96	10,66
SFA	1,00	≤	1,73	1,73	1,19	1,15
CCF	0,00	≥	Yes	Yes	Yes	Yes

VfM assessment. Since this is a hypothetical case study, for the evaluation of the created model, the VfM assessment confines with the quantitative assessment[61]. Considering the above-prepared PSC and several cases of the SB models, Figure 3.11 provides the results of VfM assessment depending on the length of period, detailed calculations of which, based on the developed model, are provided in Appendix 29.

Figure 3.10 shows the results of VfM when the SB model is prepared on the same conditions also applied in the case of PSC. It allows stating that it is expedient to determine the length of period equal to 8 years, since from that year all

[60] According to Pierce & Shoup (2013), for parking infrastructure up to 0.4 demand elasticity is expected depending on the changes of price. Regulation of price is the appropriate means for management of parking services' demand. In this case, the decrease of price can encourage higher demand for infrastructure. However, since this analysis is more focused on testing of the developed model rather than detailed analysis of the case, this assumption was not considered.

[61] The assessment of PPP's possibilities to optimize investments in public infrastructure consists of both quantitative and qualitative assessments, results of which, as disclosed in Section 2.1.5., are combined by the MCA. A numerical example of qualitative assessment and MCA is presented in the same section.

requirements of stakeholders are satisfied and there is low risk that the private entity could get over profit. At that year VfM for the PPA when NFBs are included in the assessment is nearly 17,9m EUR expressed in present value. While VfM for the users, since the price level remains the same, is 1,7m EUR, which is determined due to the assumption that the PPP allows ensuring availability of infrastructure at least 3 years earlier.

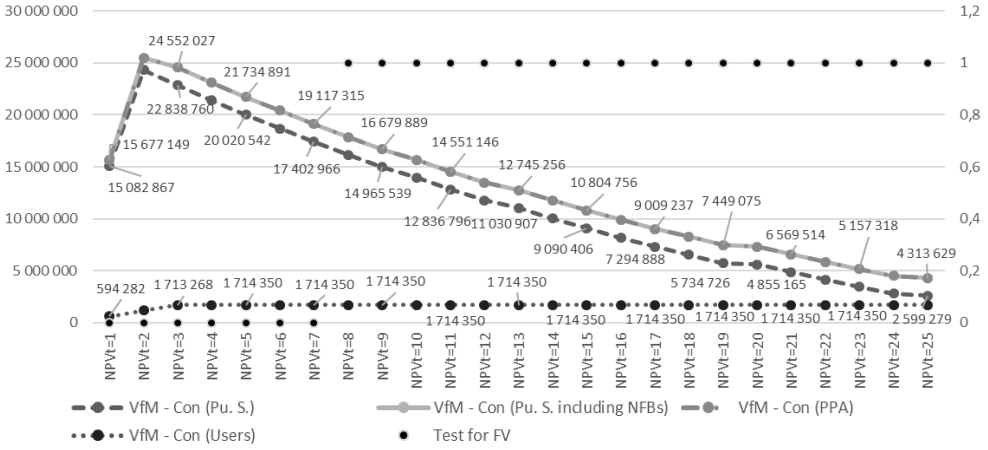

Figure 3.10. VfM and financial viability assessment when the same assumptions are applied as in the case of PSC (prepared by the author of this dissertation)

Figure 3.11 shows the results of VFM when the conditions determined in the RFP encourage competition entirely on the level of MARF. If the competition between the equity investors is strong, the PPA can expect to get revenues from the implementation of the PPP, which is equal to 40% of revenue above MARF. These revenues increase VfM for the PPA, which is equal to 19,5m EUR and it is 15,1m EUR higher in comparison with the case when the competition of MARF is not applied. VfM for users remains the same, since there are no changes related to the price level.

Figure 3.12 shows the results of VFM when the conditions determined in the RFP encourage competition entirely on the price. Since the decrease of price level is applied in both the PSC and SB model, VfM to the PPA also decreases to 16m EUR; however, this increases VfM for the users. At the end of the 25-year period it is 17m EUR and consists of both benefits: decrease of price and earlier accessibility of services. Hence, the expected benefits got by the users from the implementation of the IP as PPP are higher than the benefits expected to get by the PPA.

The comparison of this and earlier cases discloses possible interest conflict between the PPA and the users, since the PPA gets more benefit when the price level remains in the same level, contrary to the users, who prefer lower price level.

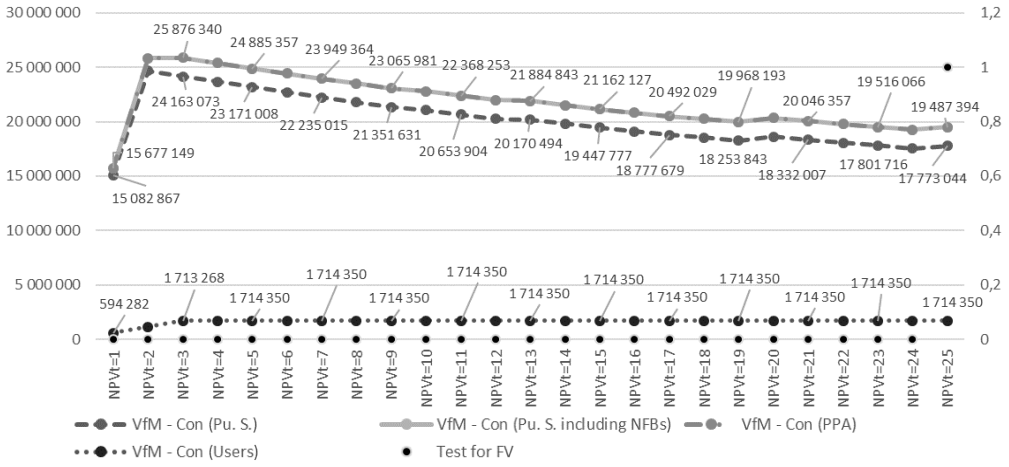

Figure 3.11. VfM and financial viability assessment when competition is focused on the level of MARF (prepared by the author of this dissertation)

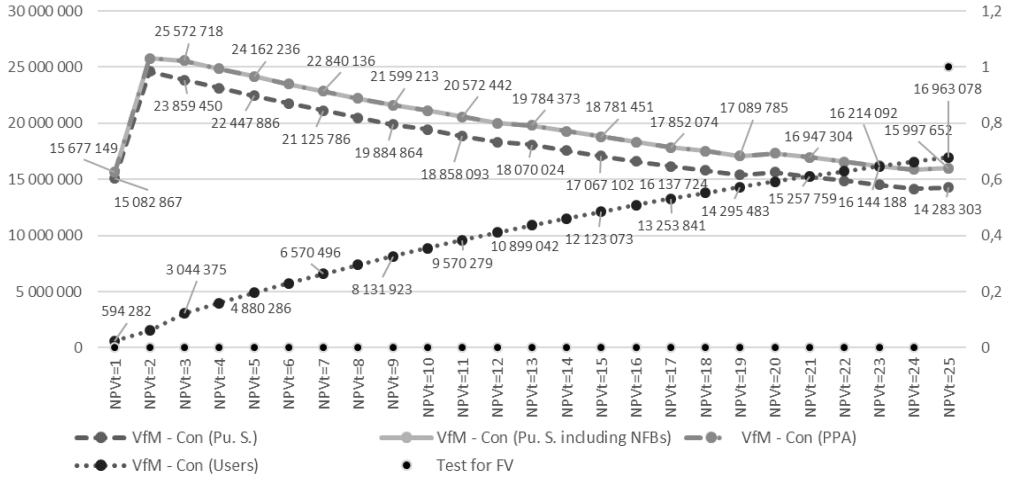

Figure 3.12. VfM and financial viability assessment when competition is focused on the price (prepared by the author of this dissertation)

Finally, Figure 3.13 shows the results of VfM when the PPA, in order to determine conditions which would protect public interests, sets the PPP monitoring tax at appropriate certain level. Since the monitoring tax is not the object of competition, the revenue received from this tax is a guaranteed source of income, which increases the VfM for the PPA, while VfM for the users remains in the same level, because the determined level of PPP monitoring tax does not leave possibilities for decreasing the price level. This case shows that the PPA, to be insured, may determine the competition conditions which can be not acceptable to the users. Accordingly, the rational decision would be to determine PPP monitoring tax at the level that also leave possibilities for price competition. However, the

proportions should be set depending on the particular IP's market competition and the priorities of the PPA.

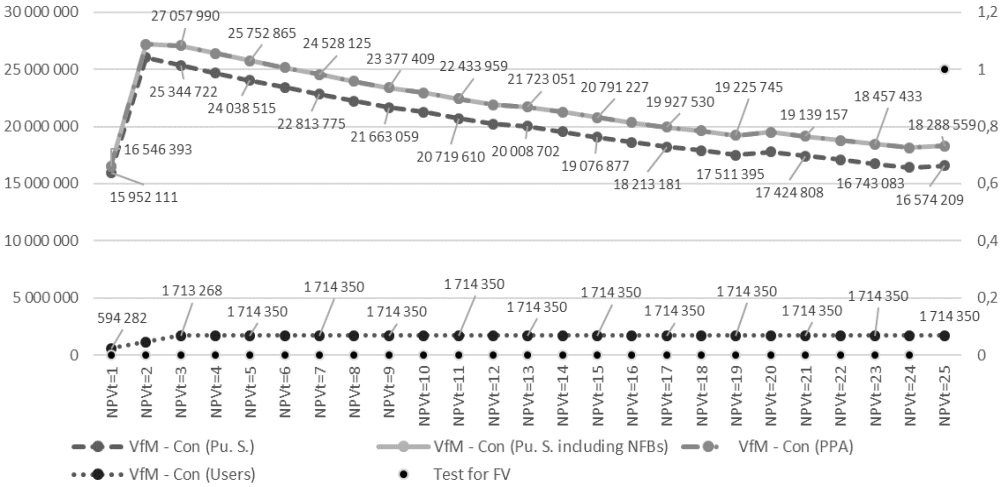

Figure 3.13. VfM and financial viability assessment when PPP contract monitoring tax increases (prepared by the author of this dissertation)

The above-made assumptions related to savings raised due to the private sector's participation enables the PPA to analyze the possibilities to implement the IP as an institutional PPP, i.e. to determine the optimal ratio of private and public capital in the general capital structure. Considering Moszoro (2010, 2014) model, this assessment, based on Formulas 15–16, requires knowing capital cost of the public and private entities, the amount of capital investments needed to build infrastructure and the expected expense savings raised due to private participation, which, considering data used to build the PSC and SB models, are provided in the Table 3.7.

Table 3.7. Variables used to determine the optimal share of public and private capital (prepared by the author of this dissertation)

	NPV			Wacc, %
	Opex	Capex	Savings	
PPA	7 483 168	19 739 529		3,6
Private entity	7 357 398	17 398 474	2 466 825	5,1

Considering the above-provided data, Figure 3.14 shows that the institutional PPP is not available in this case. Although private participation allows expecting cost savings of nearly 2.5m EUR, they are too little in comparison with the total investment costs and ratio of cost of private and public capital. A simulation of variables discloses that savings should be more than twice greater to give at least 10% of total capital structure to the private entity. While a share of 50% or higher, which is preferable to the private entity, since they get the possibility to control the

IP as discussed in the section 2.1.4., requires savings of nearly 10m EUR, which is more than a half of total investment costs.

If the assumptions would allow getting the institutional PPP, the analysis would have to be narrowed to the scope of the private investments, where capital structure optimization and financial viability analysis could be assessed as, according to the developed model, it is done in the case of the contractual PPP.

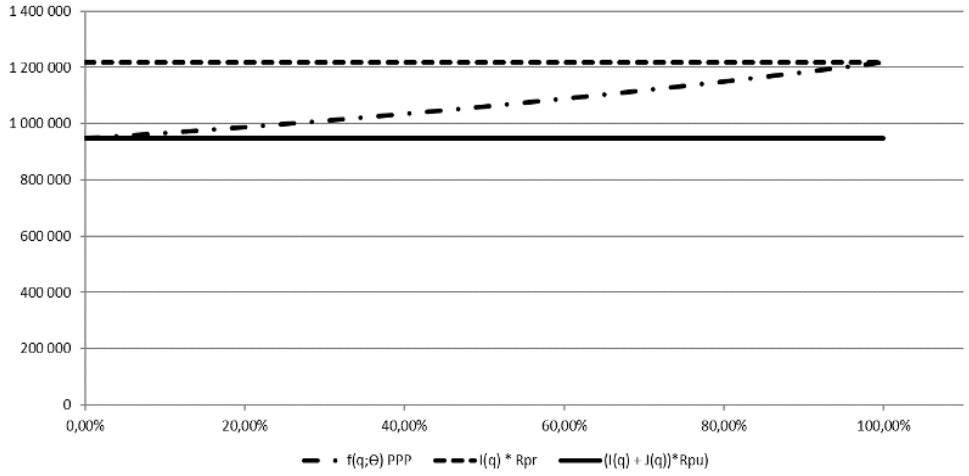

Figure 3.14. Allocation of public and private capital (prepared by the author of this dissertation)

Summarizing the results of assessment, the developed model not only allows assessing the possibilities of PPP to optimize investments in public infrastructure, but also allows the PPA to simulate various scenarios where maximum available VfM, depending on the goals and priorities of the PPA, can be achieved. It allows determining the particular length of period and other tender conditions, which allows the PPA to ensure the public interest related to the implementation of the IP as the PPP.

Depending on the CFs of the IP, the developed model also enables to analyze other scenarios. Some of them can be discussed by analyzing the case of social-based PPP model.

3.2.2.2. Social-based PPP model

To assess the possibilities of PPP to optimize investments in public infrastructure in the case of social-based PPP model, the same initial key input variables are used as have been used in the previous scenario, except the revenues are excluded from the analysis. Since it is the non-revenue generated IP, VAT of 21% is added to the costs of capital investment and O&M. Moreover, since the PPA has to cover all costs, it is expedient to release the private entity from taxes such as real estate, land rent and PPP contract monitoring. All key input variables, different from the previous cases, are provided in the same Appendix 30. As in the previous

scenario the CFs of investments, depreciation, O&M, financing, etc., used in calculations are provided for the same period of 25 years in the Appendix 31.

Stage 1. Preparatory conditions. Figure 3.15 shows the returns on investments depending on the length of the IP period, if the IP would be implemented in the conventional way. Since this is the non-revenue generating IP, all indicators are negative. The longer the period is, the larger the costs are. At the period of 25 years, NPV(I) is minus 33,5m EUR.

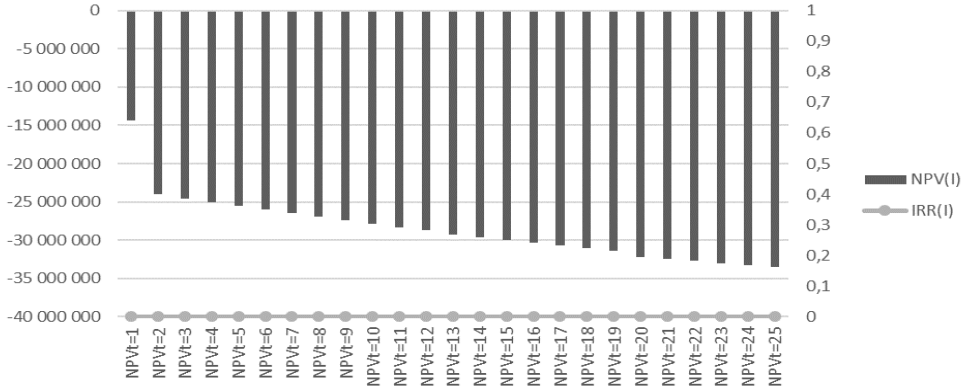

Figure 3.15. Return on investments depending on the length of period (non-revenue generated IP) (prepared by the author of this dissertation)

Stage 2. Expediency criteria. Since this scenario is the same IP as analyzed in the previous section, it satisfied the same expediency criteria for PPP potential. Only 6th criteria can be argued differently that the private entity would be compensated for the delivery of infrastructure and services by payments from the PPA, which will start to be paid, from the point when the services are available to the users.

Stage 3. PSC. Considering CFs of the IP, total risk value, calculated by applying the empirically-based PDs and their parameters, is 12,6m EUR expressed in present value at the period of 25 years. In comparison with the economic-based PPP model, it is lower than 11,3m EUR, because, since services are free of charge, there is no revenue stream and risk that changes of revenue stream could affect the financial results of the IP. Therefore, despite different allocation of demand RFs, when the PPA bears more demand RFs in comparison with the economic-based PPP model, the values of transferred and retained risks are shared in a similar proportion of 84% and 16%, that is 10,5m and 2m EUR, respectively. The results of risk assessment and allocation are provided in Appendix 32.

Since the private entity, as discussed in the beginning of this section, would be released from payment of tax of land rent, real estate and PPP monitoring tax, CN costs is equal to zero in this scenario.

Figure 3.16 shows the net present values of $FOPS_{max}$, $FOPS_{rtn}$, MP_{pr} and risk values, detailed calculation of which, based on formulas 10–12 and considering the length of reference period, are provided in Appendix 33. It allows stating that the longer the period is, the larger $FOPS_{max}$ is, because every additional year determines costs which have to be covered by the PPA. In the period of 25 years they are equal

to 46m EUR including VAT. Value of $FOPS_{rtn}$ remains stable (2m EUR) despite of the length of the period, because the PPA bears only a small part of construction task.

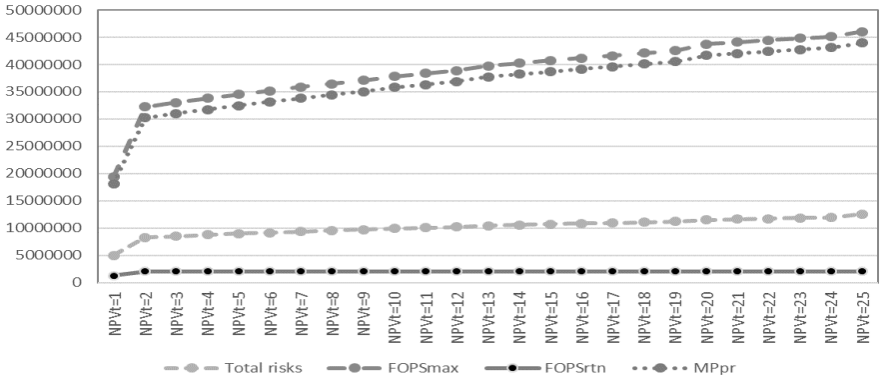

Figure 3.16. $FOPS_{max}$, $FOPS_{rtn}$, MP_{pr}, value of risk depending on the length of a period (non-revenue generated IP) (prepared by the author of this dissertation)

Figure 3.17 shows the structure of PSC which has been calculated considering the above-provided elements. Since the costs related to VAT, as discussed in Section 2.1.5., cannot be directly recovered as revenue stream by the PPA, the PSC of the PPA is higher by VAT, i.e. 6.3m EUR than it would be calculated to the public sector. Accordingly, value of 47.7m EUR expressed at present value is the threshold above which tenders with larger obligations to the PPA in a period of 25 years is considered as not giving any benefits in comparison with CP in the scope of quantitative assessment. A little bit more than 60% of this amount consists of base costs, while other costs include procurement and oversight costs, the above-mentioned VAT costs, risk costs and NFBs costs. In this case, the NFBs is the element determining the difference between $FOPS_{max}$ and PSC. Detailed calculations of PSC are provided in Appendix 34.

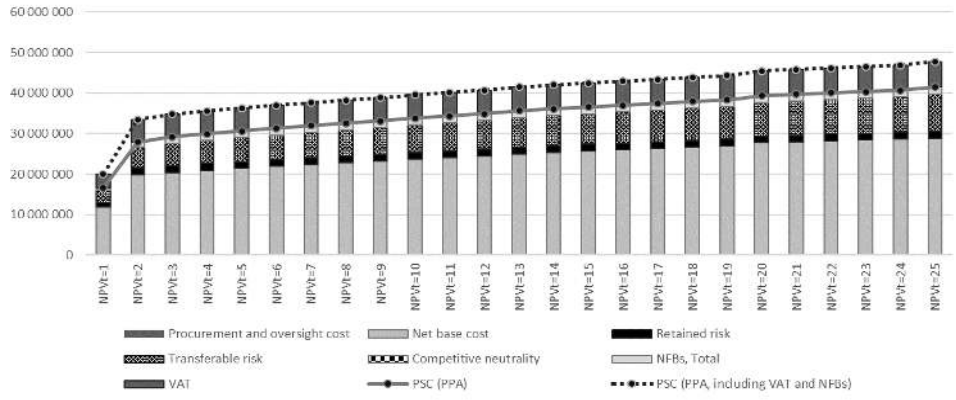

Figure 3.17. The structure of PSC (non-revenue generating IP) (prepared by the author of this dissertation)

The SB model. The SB model has been developed on the same assumptions of CFs (including cost efficiency of the private entity), capital structure, NFBs and stakeholders' requirements[62] as have been used in the previous economic-based scenario.

The only difference is that all costs of the private entity are covered by UPs from the PPA, which is the final financier of development of infrastructure and O&M. Considering the structure of private entity's cost, 5 cost groups have been identified: equity and credit, administration, maintenance, services and taxes, which have to be covered from payments of the PPA. Since the total payment is a sum of purposive payments and at the same time the variable allowing the PPA to determine revenue stream to the private entity at the level that could satisfy requirements of all stakeholders, i.e. make the PPP financially viable, it is determined considering the coefficients, which are calculated according to the same structure of the expected private entity's costs. The coefficients are provided in Table 3.8. It shows that a major part of total payments is used to cover costs of investment and financing, since the particularity of the IP is that it requires a significant amount of capital investments while the operation costs are relatively low.

Table 3.8. Structure of payments to the private entity (prepared by the author of this dissertation)

Part of payment	Coefficient
P1 - Equity, P2 - Credit	11,4
P3 - Administration	0,9
P4 - Maintenance	1,3
P5 - Services	1,7
P6 – Municipality taxes	0,9

Figure 3.18 shows the expected payments to the private entity expressed at present value. They start to be paid when the construction stage is finished and all infrastructure is accessible at full capacity to the users. They are growing due to costs, which increase every year, and inflation, which has to be included in the payments to make the SB model financially viable. At the first full year, the payment is equal to 2,9m EUR, while at the end of period it reaches the sum of 4,5m EUR. The continuous line in the figure shows the percentage difference between costs of the PPA, which would be experienced, if the IP were implemented as the PPP and in the way of CP. It allows stating that, on the one hand, the PPP makes the IP more affordable to the PPA, since it allows considerable initial capital investments exchange to constant payments, which have a lower direct impact on annual budget. However, on the other hand, the implementation of the IP as the PPP is more expensive, since it requires covering higher capital costs of the private entity.

[62] The exception is SFA indicator, which, since it is not-revenue generating IP, is not relevant in this scenario.

If the determined annual payments are not financially affordable to the PPA, the possibilities of PPP to implement the IP under lower scope in respect of lower capacity or/and lower number of tasks included in the PPP have to be analyzed, which determines that the very assessment has to be repeated from the first phases of the developed model.

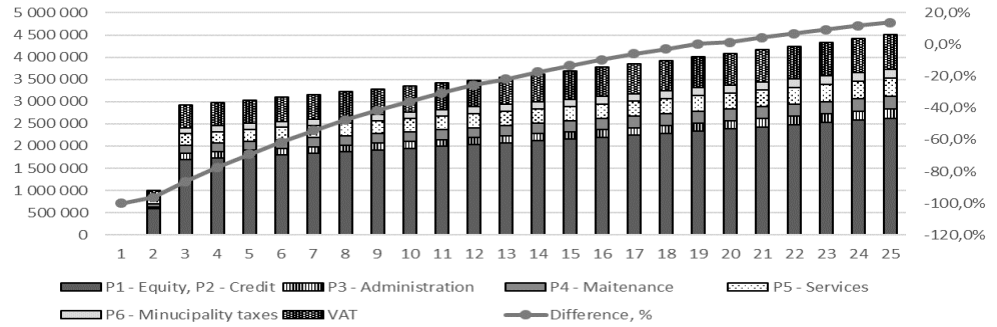

Figure 3.18. Structure of expected payments to the private entity (non-revenue generating IP) (prepared by the author of this dissertation)

Since the above-presented annual payments are adjusted by the linear optimization method at the level which allows to satisfy the requirements of all stakeholders when the period of 25 years is considered, Table 3.9 provides indicators allowing the PPA to expect that the SB model will be financially viable and attractive in the market.

Table 3.9. The results of satisfaction of stakeholders' requirements in the period of 25 years (non-revenues generating IP) (prepared by the author of this dissertation)

Indicator	Requirement	Eq.	Result	Evaluation
IRRE	12,80%	≤	12,9%	Yes
REPR	0,30	≤	0,3	Yes
DSCR	1,30	≤	1,36	Yes
LLCR	1,50	≤	4,57	Yes
PPCR	5,00	≤	9,94	Yes
CI_i - CO_i	0,00	≤		Yes

VfM assessment. Considering the developed PSC and SB models, Figure 3.19 shows the expected VfM for the PPA, the public sector in general and the users depending on the length of PPP period. It allows stating that the PPP allows expecting a more beneficial way of IP implementation than CP, since VfM is reached from all three perspectives. The PPA gets the benefits from the lower financial and socio-economic costs, while the users from the earlier accessibility of infrastructure and services. Accordingly, VfM for the PPA is 7,5m EUR, the public sector, for which VAT is not included in the assessment, 8,2m EUR and the PPA 1,7m EUR, that is 16%, 20% and 16%, respectively. This is significantly more than the expected additional costs related to the procurement of PPP (150 000 EUR) and the accepted rate of 10%. Detailed calculations are provided in Appendix 35.

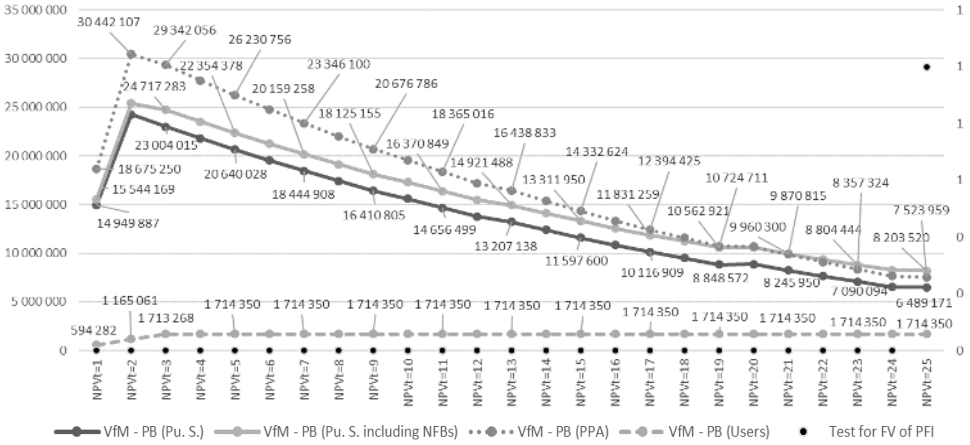

Figure 3.19. VfM and financial viability assessment (non-revenue generating IP)

Summarizing the results of assessment, the developed model enables solving the practical issues related to the assessment of PPP's possibilities to optimize investments in public infrastructure in the case of the social-based IP, by allowing developers to optimize conditions to the private sector for the cooperation in the PPP, which enables the financial viability of the IP, and to assess VfM to different stakeholders, which allows maximizing the expected benefit from the PPP, if this way of procurement is assessed as more beneficial than CP.

3.2.3. Summary of verification of the model

Since a hypothetical IP has been used, not all steps of the developed model were rational to be numerically tested for the assessment of its suitability to use in practice[63]; however, even in this scope of analysis, its real possibilities to deal with the relevant issues related to the assessment of possibilities provided by the PPP to optimize investments in public infrastructure have been clearly disclosed. The developed model practically enables to form the public sector's rational to compare option against the expected model with the appropriate level of the private sector's involvement, which also, according to the model, can be optimized in respect of cost structure, capital structure and financial viability, where the expected benefits for the PPA, the public sector in general and the users can be assessed and maximized. Moreover, the case study demonstrated the possibilities of the model to simulate various scenarios, where conflicts of interest between stakeholders can be analyzed and benefits depending on particular priorities and requirements can be maximized as well as the most appropriate combination of guarantees from the PPA can be foreseen. This allows stating that the methodological guidelines developed in this

[63] In respect of methodology, stages 4 and 5 of the model are basically repeating of previous steps of stages 3, where the main difference is, that the last two stages work with actual data, which are available only in a case of actual procurement of the PPP. Since the research is focused on possibilities, i.e. ex-ante analysis of PPP to optimize investments in public infrastructure, simulation of current stages would provide low added methodological value.

dissertation, practically combining various approaches of capital structure optimization, risk assessment and allocation, discounting, welfare maximization, etc. and providing new insights based on the performed researches allows having a flexible tool enabling to complexly solve the issues related to the assessment of PPP's possibilities to optimize investments in public infrastructure and to get concrete and measurable results. The application of this tool allows making reasonable decisions for implementation of the IP as the PPP, facilitating their communication to stakeholders, which allows assuming an increase of transparency regarding the decision-making, since their reasonableness can be easy examined. Accordingly, this dissertation, enriching the knowledge in the scientific fields of project finance and neoclassical economics, decreases a gap in literature on the issues related to the assessment of possibilities provided the PPP to optimize investments in public infrastructure.

Regarding the very case study, the assessment of the model covers only those stages which are related to the ex-ante assessment, since the dissertation is focused on the assessment of possibilities of PPP to optimize investments in public infrastructure as the most problematic part of assessment rather than the assessment of actual bids. However, since the assessment of actual bids can be assessed by the same methods, as it is explained above, it does not require numerical analysis to assess the suitability of the model to be applied in practice. The actual VfM and reliability of ex-ante VfM assessment results can be assessed when the PPP is fully implemented and closed. Since PPPs usually continue several decades there are still no actual cases in Lithuania, based on which the appropriate assessment could be performed. Moreover, the PPP agreements and related documents usually are not for public use, that in turn also determined that, instead of an actual IP, a hypothetical IP has been in this case study. Since the dissertation does not seek to assess a particular IP, but to develop a model enabling to solve the issues of assessment of possibilities provided by the PPP to optimize investments in public infrastructure, this does not decrease its scientific and practical value. Conversely, simulation of the developed model reveals it as being able to be successfully used as a practical tool allowing the developers to calculate the acceptable maximum obligation of the public sector in the PPP and to evaluate the value of the PPP in each particular case as well as can be used as an instrument allowing to determine the reasoned arguments in negotiation with entities of the private sector and, herewith, enables to make a reasoned decision for the most efficient way of IP implementation. Namely, the hypothetical case has given flexibility, which provided possibilities to simulate various scenarios, where the appropriate possibilities of the model to find the solutions could be demonstrated. The case study also confines to the quantitative assessment since the qualitative assessment and integration of both assessment results have been demonstrated in section 2.1.5.

The case study was analyzed considering the taxation policy in Lithuania that has to be taken into account by evaluating the results of the research. However, in general this consideration had no significant effect on development of the model, since the costs determined due the appropriate taxation system are the inputs but not features of the model. Therefore, in respect of these aspects, the model could be

used in other countries without any significant adjustments. According to the model, the promoters are free to calculate the costs of IP considering relevant taxation policies in both the scenario of the public sector and the private sector, where NC also have to be assessed if relevant.

The developed assumption model of calculating FDR in respect of developed formulas with the appropriate coefficients is more specifically designed to the member states of the EU. This has to be considered by applying the model outside of the EU, for which no prepared coefficients in the scope of this research are provided; it may also be relevant to revise the developed formulas to form rational assumptions for discounting.

Since the results of the case study highly depend on the assumptions applied and, more specifically, on the assessment of risk, it is important to collect data about the expected and actual costs of IP implementation, based on which the parameters of the PDs could be adjusted, which could be a part of further regular researches. Moreover, since the created model enables to simulate various cases of collaboration between the public and private entities, beside its practical purpose, it can be also used for further researches related to the collaboration of the public and private sector in the context of project finance: determination of optimal structure of payment mechanism and government guarantees to the private entities participating in the PPP and determination of typical developed model's parameters for groups of typical IPs. The first one is perspective for the determination of financial conditions encouraging right incentives from the private entities in PPPs as well as defending the interests of the PPA and the users. While the second one would allow standardizing these conditions, which, in turn, would facilitate the very assessment in various economic sectors.

CONCLUSIONS

1. The analysis of theoretical premises of the public and private sectors' collaboration in optimization of investments in public infrastructure allows making the following conclusions:
   - Market failures, the existence of natural monopolies, the presence of economies of scale in production and expectation for positive externalities are the main arguments against the provision of certain infrastructure and services being trusted to be delivered entirely by the private sector and, therefore, under the name of "public", they remain with the responsibility of the government, which, performing the assigned function, makes appropriate interventions.
   - Since it is a task and responsibility of governments to maximize benefits for disposable resources to society, it, usually facing with budgetary constraints to satisfy all social-economic needs, is encouraged to create possibilities for the involvement of the private sector's entities in provision of public infrastructure and services in cases they can provide the additional benefits in respect of quality and efficiency in comparison to those available to obtain from the conventional procurement. Accordingly, the more benefits can be expected to get from the private sector, the higher proportion of tasks of the operational level can be transferred to the private entities, herewith the more there are opportunities for the public sector to focus on its core functions: strategic planning, monitoring and regulation. Growing private participation in the public sector determines a changing role of governments and bodies on its behalf from the provider of public infrastructure and services to the strategic investor, for which the private sector, providing bigger choice of IP implementation ways, also provides more possibilities to maximize social-economic benefit to the society.
   - Involvement of the private sector in the provision of public infrastructure and services has been especially encouraged by the spread of neoliberal ideologies and the developed concept of NPM, which emphasized the importance of government's role in the adoption of innovation, efficiency and rationality of the private entities in the public sector. Along with increasing private participation in the sectors earlier exceptionally considered as the domain of the government this also highlighted the importance of its strong role in overcoming specific issues explained by the agency and related theories. This requires creating economic, legal and institutional environment favorable for the public-private cooperation and allowing to ensure effective regulation of relation between the public and private sectors as well as to create practical tools enabling to achieve the contractual arrangements, emphasized by the balance of interests between the stakeholders and best able to achieve positive VfM for the public sector.
   - Optimization of investments in public infrastructure is mostly explained through the social-economic and financial aspects. In respect of the socio-

economic aspects, it is mostly discussed in the context of economic performance and, more specifically, its productivity and efficiency, by emphasizing the importance of a well-developed and -maintained infrastructure in economic growth and increase of welfare. In respect of the financial aspects, it is focused on cost-efficiency including such aspects as the determination of optimal capital structure, minimization of life-cycle costs and optimal sharing/allocation of risks between the public and private parties. Both of them are critically important for VfM achievement, however, they are also both complicated in theory and practice.

- Collaboration between the public and private sectors is feasible, only if a compromise between all stakeholders' requirements is found. Accordingly, a shortage of public funds to satisfy the infrastructural needs, expectation of cost savings as well as specific expertise and experience, creativity and innovation from the private entities and possibility to transfer at least a part of risk are the main factors encouraging GAs to involve the private sector in the provision of public infrastructure and services. While the main motivators for the private entities to participate in a long-term partnership with the public sector are the possibility to get long-term and relatively steadier and less risky revenue that also allows expecting higher credit rating.
- The conception of evaluation of the private sector's possibilities to optimize investments in public infrastructure can be defined as a comparative assessment of all available options of investments' implementation to find the optimal one to proceed forward, i.e. the financially viable and affordable for the public sector option providing the highest available ratio of benefits and costs (VfM) to the public sector.

2. The analysis of PPP as the possibility to optimize investments in public infrastructure allows concluding the following statements:
   - Due to a complex of reasons, the concept of the PPP is not consensual; however the systemic analysis allowed defining it as the long-term contractual cooperation between the subjects of the public and private sectors, based on which the provision of public infrastructure and services is transferred to the private partner by rationally using each of the partners' competences and optimally allocating resources, costs, risks and benefits; also, due to a transfer of the private sector's knowledge, innovation and experience, creating possibilities for higher efficiency of these public infrastructure and services' provision. Besides, it is characterized by the following features: involvement of public and private entities in a long-term relationship, integration of multiple tasks in one contract, transferring of at least a part of risks to the private sector, private investments in infrastructure and provision of the private sector's specific knowledge, skills and experience to the public sector.

- Increasing acknowledgment of the PPP encouraged the rise of a wide variety of forms determining it as being able to be flexibly applied in various cases depending on particular requirements from providing secondary services to integrated bundle of designing, building, maintaining and operating the infrastructure in many economic sectors. However, since the selection of the most appropriate form and scheme of PPP has to be based on results of VfM assessment, this is a complicated task, which requires the facilitating solutions, which literature is lacking to provide.
- The advantages of PPP assert in a way which allows satisfying the same expectations that have been identified as the factors encouraging governments to collaborate with the private sector. The PPP can suggest the potential for cost-efficiency, higher quality and increased innovation in provision of public infrastructure and services. However, the possibilities to get them depend on a number of analyzed factors, which require appropriate competences from the PPAs to assess properly. Moreover, typically higher cost of capital, higher transaction costs and requirements for guarantees from the PPA and others are those disadvantages of the PPP which must be offset by the benefits to make the PPP valuable to be implemented. Therefore, the proper assessment of benefits and costs related to the implementation of IP as the PPP is critical to make a reasoned decision for the most efficient way of IP implementation. The very PPP should be considered as a well-founded decision to implement the IP in this way, by assessing all related advantages and disadvantages to it.
- The PPP as a structure by its nature is complex and includes many aspects needed to be assessed to structure it so that it could provide higher VfM for the public sector that makes this process challenging and demanding. Nevertheless, literature lacks solutions which could suggest tools allowing to complexly solve the issues related to the structuring of the best available PPP option.

3. The analysis of theoretical aspects of VfM assessment within the context of PPP allows making the following conclusions:
   - Although VfM assessment as a technique considered as the main decision-supporting tool regarding whether to implement the IP as the PPP, its conception due to complexity remains highly discussed and, depending on the applied approaches, can be used differently along with the particular advantages and disadvantages that comes with this circumstance. On the one hand, the concept of VfM assessment is very flexible and can be adjusted depending on particular requirements. However, since the results of VfM assessment highly depend on the applied assumptions, they can be rather subjective and, therefore, are highly criticized. For greater objectivity and reliance of the results it is relevant to standardize the assessment tool, which, in turn, would reduce possibilities for manipulation, whereas the results could be easily examined.

- The main differences in methodological approaches related to quantitative VfM assessment reveal in the determination and use of FDR and the preconceived attitude towards the efficiency of the PPP. However, despite these differences, all analyzed approaches tend to apply ex-ante assumptions determining the artificial advantages for the PPP in respect of higher cost efficiency of the private sector. Nevertheless, this discloses the programmed expectations from the private sector, if the private entities want to be awarded with a PPP contract, rather than the higher cost efficiency of the private sector can be considered is a rule.
- The complexity of the very PPP determines a huge variety of factors having impact on the success of PPP and results of VfM. They can be distinguished into five the main groups: technical, financial-economic, social, political-legal and management. Although scientific studies do not allow confirming that there are statistically significant differences in the importance between underlying factors in respect of different stakeholders, cost effectiveness, match of government's strategic and long-term objectives of the PPP, possibilities of an effective control mechanism over the private consortium are among those factors which are considered as the most important for the public sector. The entities of the private sector emphasize the factors related to financial interest of IP to private sector, bankability of IP, and long-term demand. While acceptability of toll/tariff level, understanding and support from the community, stable and reliable delivery of services are among those factors which are distinguished as the most important in respect of society. Considering both difficulties in compromising the interests of different stakeholders and the above-mentioned complexity of the PPP, the assessment of PPP's possibilities to optimize investments in public infrastructure and services at the current level of researches remains a complicated task and requires significant scientific impulse.

4. Considering the results of structuring the methodological approaches of assessment of PPP's possibilities to optimize investments in public infrastructure, the following summarized statements can be provided:
    - The assessment of PPP's possibilities to optimize investments in public infrastructure primarily requires preparing the public IP with the option of the highest socio-economic value. Further assessment for the PPP is mostly focused on this option's cost optimization, therefore the assessment of the financial aspects plays one of the most important roles in this process as well as it is the most discussed. The determination of FDR and assessment of risk is the center of these discussions; however, they are low-productive in methodological tools. Therefore, the methodologies for calculation of FDR and assessment of risk in public IPs have been developed. The first one suggests two approaches of determination of FDR: based on government's long-term borrowing rate and the alternative cost of private capital. Although both have equal arguments to be applied in practice, if government seeks to implement NPM methods and increase the

involvement of the private sector in the provision of public infrastructure and services, then there are more arguments to apply FDR equal to alternative cost of private capital rather than the approach based on long-term borrowing. By developing the second one, it was found that loglogistic (3P) with the determined parameters for the particular investment groups was determined as the most suitable PD to assess the Risk in the public IPs.

- Criteria such as requirement to invest in infrastructure, long-term demand of infrastructure and services, complexity of transferred services, possibility to measure the out of services, possibility of sharing and allocation of risk, clear revenue stream to the private entity, interest of the private entities with the IP were distinguished as enabling to assess the expediency of IPs to be fully analyzed for its possibilities to be implemented as the PPP and to justify usually higher transaction costs of this assessment.
- To be rational to compare against the private bids, the PSC needs to include a variety of cost elements covering both financial and socio-economic costs. Depending on the perspective, the PPA or the public sector, in general, the PSC is calculated, it may differ in respect of taxes, since not all costs related to tax expenditure directly come as revenue stream to the PPA. Therefore, PSC's cost as a benchmark can be higher in the case of the PPA than in the case of the public sector. Nevertheless, the structuring of PSC not only assists in analyzing VfM, but also promotes the understanding of importance of whole life-cycle cost assessment to make the reasoned decision for the most efficient ways of IP implementation.
- The structuring of the SB model reflects the best efforts of the PPA to evaluate the expected life-cycle cost of IP implementation for the PPA or the public sector in general, if it were implemented with the determined level of the private sector's involvement. For rational comparison against the PSC, it requires to be financially viable and affordable as well as to be characterized by efficient sharing/allocation of risk, optimal capital structure and efficient payment mechanism.
- VfM assessment may consist of both qualitative and quantitative assessment, the results of which are combined by using MCA framework. The larger uncertainty with the results of quantitative assessment is, the more important qualitative assessment becomes. This discloses the technique of VfM assessment being able to be flexible depending on requirements. However, the quantitative assessment remains a fundamental part of assessment of PPP's possibilities to optimize investments in public infrastructure. Considering the features of the PSC model and the SB model, the developed methodology of VfM assessment mostly focuses on the comparison of financial impact of estimated risk-adjusted cost elements to the PPA or the public sector. However, it also allows assessing VfM for the users who may assert in the form of decrease of price level or/and

additional external socio-economic benefits due to IP implementation as the PPP.

- According to the theoretical aspects of assessment of PPP's possibilities to optimize investments in public infrastructure, a complex model enabling to perform this assessment was developed, which consists of five main stages: 1) preparation of the initial IP; 2) selection of IP for PPP; 3) PPP feasibility analysis; 4) VfM assessment of actual bids, and; 5) VfM monitoring. The created model reflects the integrated complex approach to assessment of PPP's possibilities to optimize investments in public infrastructure and characterizes the actions (process) of this assessment, by including the structuring of both rational to compare the PSC model and the optimal PPP model as well as their rational comparison, where VfM assessment could be evaluated.

5. The results of the empirical verification of the developed model allow making the following conclusions:
   - Depending on the applied approach, the FDR may significantly differ which, in turn, affects the results of VfM assessment. Therefore, it is relevant to evaluate whether the application of different FDRs determines a different outcome regarding the choice of the optimal way to implement the IP. Accordingly, if the FDR of appropriate level becomes the critical factor determining whether to go into the PPP, the weights of qualitative assessment's results have to be increased by making decision for the optimal way of investment implementation.
   - In the public IPs of Lithuania, the planned capital costs are exceeded on average by a quarter, which discloses a certain tendency of cost overrun risk. The results differ between investment groups, but only the differences in risk estimates between investments into construction and equipment can be confirmed as statistically significant, which allows clearly stating that cost overrun risk related to investments into construction is significantly higher than into equipment. Meanwhile, a comparative analysis of empirically-grounded REs with the theoretical ones revealed the cost overrun risk being on average overestimated by a quarter in Lithuania.
   - To verify the suitability of the created model to solve the particular issues arisen in this dissertation, the assessment of PPP's possibilities to optimize investments in public infrastructure was performed in the case study. The results of verification allow persuading the suitability of the created model to assess the possibilities provided the PPP to optimize investments in public infrastructure and to get reliable results in every step of the assessment. The created model enables to structure the best public sector option which is rational to compare against the private bids, to determine maximum allowed obligations of the PPA in the PPP, to structure the optimized IP's option with the appropriate level of the private sector's involvement, to assess its affordability to the PPA as well as VfM of IP's implementation as the PPP.

- Verification of the created model was based on a hypothetical case study, since the dissertation does not seek to assess a particular IP, but develop a model enabling to solve the issues of the assessment of possibilities provided by the PPP to optimize investments in public infrastructure. Accordingly, the hypothetical case study enabled to simulate various scenarios, where the possibilities of the model to solve a variety of practical issues could be examined.
- Two further research directions in field of assessment of PPP possibilities to optimize investments in public infrastructure are recommended: formation of optimal model of payment mechanism and government guarantees to the private entities participating in the PPP, and determination of standardized parameters of the created model's elements for the typical IPs.

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APPENDICES

Appendix 1

Key aspects in definitions of PPP (prepared by the author of this dissertation)

Definitions	key aspects										
	Long-term period	(Contractual) Agreement	Cooperation, Partnership	Delivery of infrastructure	Delivery of services	Risk sharing and allocation	Delegation	Financing	Competence	Innovation	Procurement
(Ashuri et al., 2012) "A contractual agreement between a public agency (federal, state or local) and the private sector entity".		1									
(Carbonara et al., 2014) "the agreements where public sector bodies enter into long-term contractual agreements with private sector entities for the construction or management of public sector infrastructure facilities by the private sector entity, or the provision of services by the private sector entity to the community on behalf of a public sector entity".	1	1		1	1						
(Gordon et al., 2013) "A contractual agreement between a public agency (federal, state or local) and a private sector entity".		1					1				
(Grimsey & Lewis, 2002) "The agreements where public sector bodies enter into long-term contractual agreements with private sector entities for the construction or management of pubic sector infrastructure facilities by the private sector entity, or the provision of services (using infrastructure facilities) by the private sector entity to the community on behalf of a public sector entity".	1	1		1	1		1				
(Gudelis & Rozenbergaitė, 2004) "A collaboration of the public and private sectors, of which essence is to provide services traditionally attributed to competence of the public sector and develop infrastructure needed for their delivery".		1		1	1						
(Liu et al., 2015) "The relationships formed between private sector and public bodies often with the aim of introducing private sector resources and/or expertise in order to provide and deliver public sector assets and services".				1	1			1	1		
(Molen et al., 2010) "A risk-sharing relationship based upon an greed aspiration between the public and private (including voluntary) sectors to bring about a desired public policy outcome". "An innovation-based relationship, that involves, at least partly, a significant effort in research and development'. "Risk-sharing and innovation-based relationship between public and private actors to bring a desired public policy and involving a significant effort in						1				1	

research and development".											
(Mu et al., 2011) "Cooperative institutional arrangements between the public and private sectors".		1									
(Poulton & Macartney, 2012) "Cooperation of some sort of durability between public and private actors in which they jointly develop products and services and share risks, costs, and resources which are connected with these products"		1		1	1	1		1			
(Roehrich et al., 2014) "A long-term contract between a private party and a government agency, for providing a public asset or service, in which the private party bears significant risk and management responsibility".	1	1		1	1	1					
(Roll & Verbeke, 1998) "A tool for financial and administrative cooperation between Member States' governments or the EU and private investors".			1					1			
(Rudžianskaitė–Kvaraciejienė et al., 2015) "A collaboration between public and private sectors based on a long term agreement which aims to provide services traditionally assigned to the competence of the public sector and to maintain the infrastructure necessary for the development of those services".	1	1	1	1	1		1				
(Sambrani, 2014) "An agreement between the government and private sector for the purpose of provisioning of public services or infrastructure".		1			1	1					
(Shaoul et al., 2012) "A long-term relationship between a public sector procurer and multiple private sector companies exists to design and construct infrastructure, maintain it and provide some related services".	1			1	1						
(Sharma, 2007) "An agreement between government and businesses or non-government organizations (NGOs) for the provision of services by sharing of risks and rewards of the venture".		1			1	1					
(Skietrys & Raipa, 2009) "Intermediate normal procurement option through the public authorities and the full privatization".											1
(Tamosiunas & Zilakauskyte, 2010) "An agreement between public and private sectors in developing public infrastructure, in meeting the vital needs of the community or in providing other related services".		1		1	1						
(Urbonavicius, 2010) "One of the procurement form, in which the public and private sectors cooperate with each other in search of the most appropriate form".			1								1
(Felix; Villalba-Romero & Liyanage, 2016) "An agreement between a government and one or more private partners (which may include the operators and the financiers) by which the private partners provide the service in such a manner that the service delivery objectives of the government are aligned with the profit objectives of the private partners and where the effectiveness of the alignment depends on a sufficient transfer of risk to the private partners".		1			1	1					

(Xueqing Zhang, 2011) “A contractual relationships governing a long-term public sector acquisition and private sector provision of public works and services”.	1	1		1	1						
(Xu et al., 2012) “A contractual business relationship between government and private entities”.		1	1								
(Zangoueinezhad & Azar, 2014) “A long-term contractual relationship between a public body and a private partner (or a consortium of private firms) for the construction and operation of infrastructure”. “A cooperative venture between the public and private sectors built on the expertise of each partner that best meets clearly defined goals through the appropriate allocation of resources, risks and rewards”. “Reciprocal obligations and mutual accountability, voluntary or contractual relationships, the sharing of investment and reputational risks, and joint responsibility for design and execution”	1	1	1	1		1					
(Wojewnik-Filipkowska & Trojanowski, 2013) “Various options of cooperation between public and private entities”.			1								
(European Commission Directorate General Regional Policy, 2003) “A partnership between the public sector and the private sector for delivering a project or a service traditionally provided by the public sector. PPPs recognize, that both parties have certain advantages relative to the other in the performance of specific tasks. By allowing each sector to do what it does best, public services and infrastructure can be provided in the most economically efficient manner”			1	1	1				1		
(LR Ministry of Finance, 2014) “An agreement’s form of the public and private sectors, which requires financial, technological, experience and other investments from the private partner, in which management of the main risks is transferred to the private sector, while the public sector pays for the private one for delivery of services traditionally provided by the public sector”.		1				1		1	1	1	
(LR Profit tax law, n.d.) “A collaboration ways of the state and local government and the private entity established in law, in which institutions of government or municipality transfer the functions assigned them to the private party, whereas the private subject invests in this activity and the infrastructure needed for its performance in return for a statutory compensation”.			1		1	1		1			

Appendix 2

List of schemes of collaboration between the public and private entities
(prepared by the author of this dissertation)

Build-develop-operate (BDO)
Build-lease-operate-transfer (BLOT)
Build-operate-training-transfer (BOTT)
Build-operate-transfer (BOT)
Build-operate–transfer (BOT)
Build-own-operate (BOO)
Build-own-operate-shell (BOOS)
Build-own-operate-transfer (BOOT)
Build–own–operate–transfer (BOOT)
Build-rent-own-transfer (BROT)
Build-transfer (BT)
Build-transfer-operate (BTO)
Buy-build-operate (BBO)
Design-build-finance-maintain- operate (DBFMO)
Design-build-finance-operate (DBFO)
Design-build-finance-transfer (DBFT)
Design-build-maintain (DBM)
Design-build-maintain-transfer (DBMT)
Design-build-operate (DBO)
Design-build-operate-finance (DBOF)
Design-build-operate-transfer (DBOT)
Design-build-transfer (DBT)
Design-construct-manage-finance (DCMF)
Enhanced-use-leasing (EUL)
Lease/Purchase (L)
Lease-build-operate (LBO)
Lease-develop-operate (LDO)
Lease-upgrade-operate-transfer (LUOT)
Maintain-manage (MM)
Operate-maintain (OM)
Rehabilitate-operate-manage (ROM)
Rehabilitate-operate-transfer (ROT)
Transfer-operate-transfer (TOT)

Since ownership and status (new build or existing) of infrastructure are one of the most important aspects related to various arrangements of PPP, it is able to distinguish 3 groups of PPP schemes, respectively (Table).

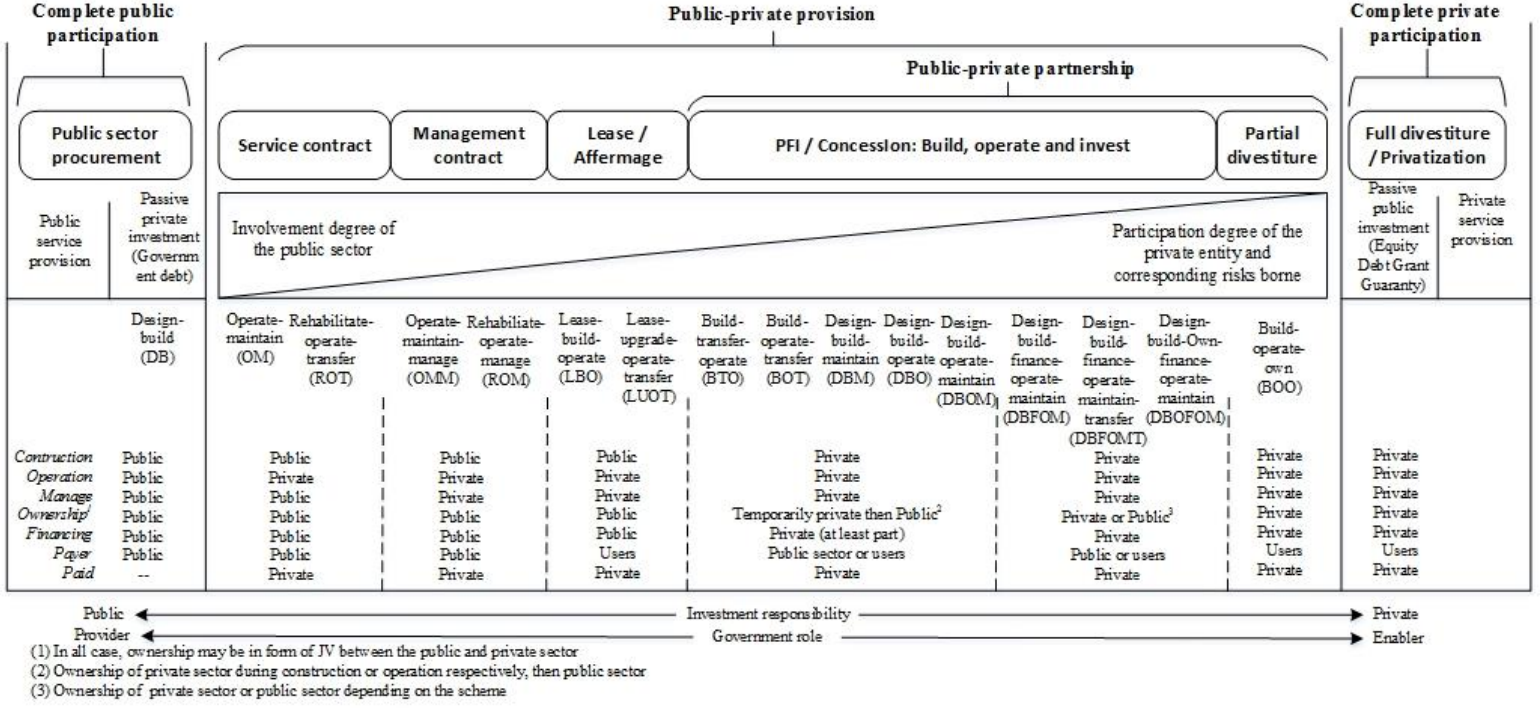
Table. Groups of PPP schemes (prepared according to Hemming, (2006))

Group	Schemes	Definition
1	Build-own-operate (BOO) Build-develop-operate (BDO) Design-construct-manage-finance (DCMF)	The private sector designs, builds, owns, develops, operates, and manages an asset with no obligation to transfer ownership to the government. These are variants of design-build-finance-operate (DBFO) schemes.
2	Buy-build-operate (BBO) Lease-develop-operate (LDO)	The private sector buys or leases an existing asset from the government; renovates, modernizes, and/or expands it; and then operates the asset, again with no obligation to transfer ownership back to the government.
3	Build-operate-transfer (BOT) Build-own-operate-transfer (BOOT) Build-rent-own-transfer (BROT) Build-lease-operate-transfer (BLOT) Build-transfer-operate (BTO)	The private sector designs and builds an asset, operates it, and then transfers it to the government when the operating contract ends, or at some other prespecified time. The private sector partner may subsequently rent or lease the asset from the government.

The first group includes schemes based on which the private entity on its own coherently performs all activities and remains the owner of infrastructure over the entire life cycle of IPs and beyond. The second group consists of similar schemes as in the previous case, however, the private entity acquires the existing infrastructure, which the private entity usually has to rehabilitate, upgrade or modernize it. The third includes the schemes, in which at the end of collaboration period or after completion of investment period property rights of build infrastructure is transferred to the public entity. For the transferred assets, the private entity is remunerated by its residual value, usually for less than its true residual value (and often at zero or a small, nominal cost). Considering requirements of the public sector to keep ownership of asset, the schemes of the last group are the most prevailing in practice.

Appendix 3

Public and private provision of infrastructure and services (adopting from de Jong et al. (2010))



(1) In all case, ownership may be in form of JV between the public and private sector
(2) Ownership of private sector during construction or operation respectively, then public sector
(3) Ownership of private sector or public sector depending on the scheme

Appendix 4

Differences of quantitative VfM assessment methodologies (prepared according to (Burger & Hawkesworth, 2011; Commonwealth of Australia, 2008; EPEC, 2015b; FWHA, 2012; HM Treasury, 2006; Infrastructure Ontario, 2015)

Country	Costs identification	Risk reflecting	PV calculation	Reasons for differences
UK	The CF of both PPP and CP options are adjusted based on expected optimism bias.	The CF of both PPP and CP options are adjusted based on risk adjusted expected values.	DR is standardized for all public IP appraisals. It is expressed in real terms, and is adjusted to a nominal rate by adding a prescribed inflation assumption. It is fixed and, unlike actual cost of financing approach equals the STPR.	1. The impact of optimism bias and risk adjusted CFs. 2. Difference between the cost of private capital and the public DR.
FR	Typically, cost and revenue estimations for the PPP option and the CP option are not identical, based on the notion that the private partner is likely to generate life cycle cost optimizations	Both the volatility of CFs and events with a negative impact such as higher expected costs/delays are captured by a correction to the CFs. The Monte Carlo Simulation technique is used to modify the original 'non-risk adjusted' CFs to risk-corrected values.	DR is equal to borrowing rate of the public sector entity, since assessment focuses on the financial assessment from a microeconomic perspective, i.e. from the procuring authority financing level.	1. Different assumptions for the capex and opex due to the assumed efficiency of the PPP partner; 2. Different assumptions in the risk valuation through CFs for the CP option and PPP options. 3. Difference between the cost of private finance and the public DR.
DE	Typically, not cost estimations for the PPP and CP options are not identical, based on the notion that the private partner is likely to generate life cycle cost optimizations	Risk calculation between the CP option and the PPP option (except in case of specifically identified differences). The adjustment for risk is through the CFs	DR equal to the costs of loan of which maturity is equivalent to PPP project loan in the market.	1. Different assumptions for the capex and opex due to the assumed efficiency of the PPP partner; 2. Difference in DRs of the PPP partner and the PPA
NL	Cost and revenue estimations for the PPP option and the CP option are not identical. Efficiency factor is applied to capital and	Risk adjustments are through CFs and for the CP and PPP options are identical.	DR equals to market based government borrowing rate including risk premium.	1. Assumptions about differences in operational cashflows. 2. In the procurement phase, small differences may occur

	operational expenditures of the PPP partner.			between the market based discount rate and the actual private cost of capital
BE			DR equals market based government borrowing rate including risk premium.	
CAN			DR is equal to the approximate costs of average life loan	
AUS	Typically, CFs estimations for the PPP option and the CP option are not identical. The private bids may incorporate additional innovations which can make it cheaper or more expensive for government to deliver infrastructure and services.	Risk adjustment are preferable through CFs and for the CP and PPP options, and it is identical.	DR equals risk-free rate plus systemic risk premium. The more Systematic Risk transferred to the private sector, the higher the DR should be to evaluate that option.	1. Assumptions about differences in operational CFs. 2. Difference between the cost of private capital and the DR of the CP option.

Appendix 5

Comparison of CSFs for PPP amongst the three stakeholders (according to S. T. Ng et al., (2012))

Code	CSFs	All respondents		Public sector		Private sector		Community	
		Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
S4	Level of toll/tariff is acceptable	5,78	1	6,02	3	5,4	7	6,13	1
T4	Availability of experienced, strong and reliable private consortium	5,72	2	5,88	6	5,78	2	5,51	8
S1	There is a long-term demand of the products/service in the community	5,72	3	5,83	8	5,43	4	5,89	4
O9	Matching government's strategic and long-term objectives	5,71	4	6,1	2	5,53	5	5,64	7
S3	Delivery of services is stable and reliable	5,71	5	6	4	5,35	9	5,98	3
F4	IP is of financial interest to private sector	5,67	6	5,75	9	5,93	1	5,23	16
F1	IP is more cost effective than traditional forms of IP delivery	5,66	7	6,17	1	5,21	16	5,87	6
S2	The community is understanding and supportive	5,62	8	5,85	7	5,23	15	6	2
O8	Possibility of an effective control mechanism over the private consortium	5,56	9	5,92	5	5,14	19	5,89	4
F6	IP is bankable and profitability of the IP is sufficient to attract investors and lenders	5,47	10	5,21	25	5,68	3	5,4	10
F2	IP can be substantially self-funded or on a non-recourse basis	5,35	11	5,56	12	5,15	18	5,47	9
P5	There is a favorable legal framework (mature, reasonable and predictable)	5,34	12	5,29	21	5,35	9	5,38	11
O5	Flexible to decide appropriate risk allocation	5,31	13	5,56	12	5,14	19	5,36	12
T2	Possibility of innovative solutions (e.g. leading to time/cost savings	5,3	14	5,35	16	5,31	12	5,23	16
F8	Existence of a sound governmental economic policy	5,3	15	5,23	24	5,43	6	5,19	18
T5	Service quality can be easily defined and objectively measured	5,27	16	5,69	10	5,21	16	4,98	24
P4	The project is compatible with current statutory and institutional arrangements	5,2	17	5,29	21	5,09	23	5,28	14
P3	There is political support for the IP	5,18	18	5,1	27	5,36	8	4,98	24
F7	Economic environment is stable and favorable	5,14	19	4,94	33	5,25	14	5,15	20

S6	IP is environmentally sustainable	5,13	20	5,33	18	4,89	26	5,3	13
T3	Availability of Government experience in packaging similar PPP IPs	5,13	21	5,08	28	5,13	21	5,17	19
O4	Supportiveness and commitment of staff to the IP	5,1	22	5,6	11	4,88	27	4,98	24
O7	Authority can be shared between the public and private sectors	5,1	23	5	30	5,06	24	5,25	15
P2	Political environment is stable	5,1	24	4,96	31	5,3	13	4,92	28
F3	IP value is sufficiently large to avoid procurement disproportionate procurement costs	5,09	25	5,31	29	5,13	21	4,82	30
T6	Contract is flexible enough for frequent change in output specification	5,06	26	5,48	14	4,81	28	5,06	22
O6	Support from the government (e.g. guarantee or loans) is available	5,06	27	4,96	31	5,33	11	4,74	31
T1	IP size is technically manageable by a single consortium	5	28	5,17	26	4,91	25	4,98	24
O1	Fairness of new conditions to employees	4,98	29	5,42	15	4,71	32	5	23
S5	IP can create more job opportunities	4,95	30	5,29	21	4,76	30	4,92	28
P1	IP is not politically sensitive	4,93	31	5,02	29	4,75	31	5,13	21
O3	Existence of a resolution for any civil service staff redundancy	4,81	32	5,35	16	4,6	34	4,62	33
O2	Possibility of significant redundancy	4,76	33	5,31	19	4,46	35	4,7	32
F5	IP can attract foreign capital	4,65	34	4,54	35	4,8	29	4,53	34
T7	IP is not susceptible to fast-laced change (e.g. technological change	4,52	35	4,56	34	4,65	33	4,3	36
F9	Competition from other IPs is limited	4,31	36	4,04	36	4,46	35	4,34	35

Note: Items were rated on a 7-point Likert scale with 1 - strongly disagree and 7 - strongly agree

Appendix 6

Cost of equity estimation models (according to Gözen (2013))

Table 1. CAPMs

Models	Description
A - Models standard for the international setting	
The Global[a] CAPM	$R_e = R_{fw} + \beta_w (R_{mw} - R_{fw})$
B - Models including additional risk premium, in general for country risk	
Depending on the country where the investment is made, an additional risk premium (R_a) is added to the cost of equity estimated by CAPM (Sabal, 2004: 155-166).	
Country risk premium (R_c) is added to the CAPM formula instead of usually the U.S. market risk premium of $(R_{mu} - R_{fu})$ (Sabal, 2004: 155-166). Then the formula could be written as $R_e = R_{fu} + \beta_u R_c$	
Country risk premium is added usually to U.S. market risk premium (*The Beta Approach)* $(R_{mu} - R_{fu} + R_c)$ (Damodaran, 2003a: 63-76, 2009b, 2010).	
Country risk premium is added to the cost of equity estimated by CAPM usually for a U.S. asset, $R_e = R_{fu} + \beta_u (R_{mu} - R_{fu}) + R_c$ (*The Bludgeon Approach*). The same calculation is done by multiplying R_c with a parameter (*namely Lambda*) to convert the calculation to the company level (*The Lambda Approach*). For different ways of calculating country risk premium and other details, see Damodaran (2003a: 63-76, 2003b, 2009b, 2010).	
Sovereign spread is added instead of the risk-free rate and formulated as $R_e = R_s + \beta_w (R_{mw} - R_{fw})$ *(The Goldman Sovereign Spread Model)* (Harvey, 2005).	
For the calculation of beta and market risk premium, local data are used. Instead of the local risk-free rate, global risk-free rate is used and country risk premium is added to it. $R_e = R_{fw} + R_c + \beta_l (R_{ml} - R_{fl})$ *(The Local CAPM)* (Pereiro, 2006: 160-183).	
The cost of equity is calculated by adding the country long-term debt rate and the global market risk premium (*The U.S. market is assumed to represent the global market*), or by adding the cost of equity for a U.S. utility and the country risk premium (Voll et al., 1998). The latter is identical to the Bludgeon Approach.	
C - Models including country/sovereign risk premiums with adjusted/modified risk factors	
The Goldman Sachs Model	$R_e = R_{fu} + R_c + \beta_l (R_{mu} - R_{fu})(1-\rho_{sb})(\sigma_c / \sigma_u)$ *where* $0 < \rho_{sb} < 1$
The Goldman Sovereign Spread Volatility Ratio Model	$R_e = R_s + (\sigma_c / \sigma_u)(R_{mw} - R_{fw})$
The Godfrey and Espinosa Model	$R_e = R_{fu} + R_c + 0.60(\sigma_c / \sigma_u)(R_{mu} - R_{fu})$
The Adjusted Hybrid CAPM	$R_e = R_{fw} + R_c + \{\beta_c [\beta_{gu} (R_{mw} - R_{fw})]\}(1-R_2)$
The Lessard Model	$R_e = R_{fu} + R_c + (\beta_p \beta_c)(R_{mu} - R_{fu})$
The Salomon Smith Barney Model	$R_e = R_{fw} + \{(\gamma_1 + \gamma_2 + \gamma_3)/30)\} R_c + \beta_p (R_{mw} - R_{fw})$ *where* $0 \leq \gamma_n \leq 10$
D - Models with adjusted/modified beta	

The Adjusted Local CAPM	$R_e = R_{fw} + \beta_l (R_{ml} - R_{fl})(1 - R_i^2)$
The Modified International CAPM	$R_e = R_{fu} + \beta_{wp} (R_{mw} - R_{fw})$, Either world or the U.S. market risk premium is used (Sabal, 2004).
E - Models with risk factors other than beta	
Estrada's Downside Risk Model	$R_e = R_{fu} + RM(R_{mw} - R_{fw})$
Arbitrage Pricing Theory	$R_e = R_f + \beta_1 f_1 + \beta_2 f_2 + \ldots + \beta_n f_n$
F - Other models	
The Erb, Harvey, and Viskanta Model	$R_e = \varepsilon_0 + \varepsilon_1 lnCR$, where ε_0 and ε_1 are regression parameters. Country credit rating is available twice a year and the return is semi-annual.
The Implied Cost of Capital Model	$P_t = \sum_{t=1}^{\infty} \frac{CF_t}{(1+R_e)^t}$ This model aims at finding R_e from this equation in the international market.
The Bekaert and Harvey Model	$R_e = R_{fl} + (1-\lambda)\beta_l (R_{ml} - R_{fl}) + \lambda \beta_w (R_{mw} - R_{fw})$
The Ibbotson Bayesian Model	It is a hybrid of the global CAPM.

Table 2. Nomenclature for Table 1

Parameter	Definition
R_e	The cost of equity
R_f , R_{fl} , R_{fu} , R_{fw} , R_{fb} , R_s	The risk-free rate, the local risk-free rate, the U.S. risk-free rate, the global risk-free rate, the stripped yield of a Brady bond, and the sovereign spread respectively
R_{ml} , R_{mu} , R_{mw}	The local market return, the U.S. market return, and the global market return respectively
β_l	The beta of the local company computed against the local market index
β_u	The beta of the U.S. company computed against the U.S. market index
β_W	The beta of the local company computed against the global market index
R_c	The country risk premium
R_a	Additional risk premium depending on the country where the investment is made.
β_p	The beta of the relevant industry with respect to the world market. This parameter refers to the industry beta in the SalomonSmithBarney Model. On the other hand, it refers to the beta of a U.S. based project, which is a proxy for a foreign project in the Lessard Model.
β_c	The beta of the relevant country with respect to the world/U.S. market. This refers to the relative sensitivity of the returns of the local stock market to the U.S. market returns in the Lessard model. It refers to the slope of the regression between the local equity market index and the global market index in the Adjusted Hybrid Model.
β_{cr}	The beta of the relevant country with respect to the region concerned.
β_{gu}	The average unlevered beta of comparable companies listed in the global market. It requires releveling with the target leverage.

β_n	The sensitivity to factor *n*.
B_{wp}	The weighted beta of projects in different locations (Sabal, 2004: 155-166).
ρ_{sb}	The correlation between the stock and bond markets of the country
$\sigma_{c,}$, σ_{ce} , σ_{cd}	The standard deviation of returns in the local equity market
σ_u	The standard deviation of returns in the U.S. equity market
γ_1	A firm related score indicating access to capital markets, $0 \leq \gamma_1 \leq 10$, and a score of 0 indicates the best access.
γ_2	The susceptibility of the industry to political intervention, $0 \leq \gamma_2 \leq 10$, a score of 0 indicates the least susceptibility.
γ_3	The portion of the firm's total assets at the local level, $0 \leq \gamma_3 \leq 10$, a score of 0 indicates that the investment at the local level constitutes only a small portion.
CR	Country credit rating of the relevant country

Table 3. The models: their appearances in the literature and short descriptions Models

Models	Date	Short description of the models
The Standard CAPM[a] (Sharpe, 1964: 425-442; Lintner, 1965: 13-37; Black, 1972: 444-455)	1964	The local parameters are used in the CAPM formula. Due to its methodology, there is no need to add a country risk premium.
The Arbitrage Pricing Model (Ross, 1976: 341-360)	1976	The model foresees more than one risk factor compared with the single beta of CAPM, but there is no answer for the type and number of possible risk factors.
The Goldman Sovereign Spread Model (Mariscal and Lee, 1993; Harvey, 2005)	1993	It recommends the addition of a sovereign spread instead of the risk-free rate.
The Goldman Sovereign Spread Volatility Ratio Model (Harvey, 2005)	1994	Sovereign spread is added instead of the risk-free rate and the relative volatility of markets are multiplied by the market risk premium. Alternatively, Harvey (2005) proposes to calculate the volatility by the same methodology of the Implied Sovereign Spread Model.
The Erb-Harvey-Viskanta Model (Erb et al., 1995, 1996: 46-58)	1995	The cost of equity is associated with country credit rating.
The Bekaert and Harvey Model (Bekaert and Harvey, 1995: 773-816)	1995	CAPM is reformulated with time-varying market integration. It is a dynamic model and combines both local and global CAPMs in a single formula.
The Implied Sovereign Spread Model proposed by Erb, Harvey, and Viskanta (Erb et al., 1996: 46-58; Harvey, 2005)	1996	Sovereign spread is calculated by running a regression of observed sovereign spreads on country risk ratings. This is advised to calculate the sovereign spread as an

		alternative to the Goldman Sovereign Spread Model.
The Lessard Model (Lessard, 1996: 52-63; Pereiro, 2006: 160-183)	1996	Country risk premium is added to the CAPM and modified betas (*country beta and industrial beta*) are used.
Godfrey and Espinosa Model (Godfrey and Espinosa, 1996: 80-89; Pereiro, 2006: 160-183)	1996	Country risk premium is added to the CAPM and relative volatility of the market returns of the local and U.S. markets are used instead of beta.
The CSFB Model (Harvey, 2005)	1997	A relatively complex beta adjustment is used.
The Global CAPM (O'Brien, 1999: 73-79; Stulz, 1999: 8-25; Schramm and Wang, 1999: 63-72)	1999	The global parameters are used instead of local parameters. Due to its methodology, there is no need to include a country risk premium.
The Goldman Sachs Model (Mariscal and Hargis, 1999; Pereiro, 2006: 160-183)	1999	Country risk premium is added to the CAPM and instead of beta as a risk factor; the relative volatility of the market returns of the local and U.S. markets and the correlation of equity and debt markets of the local country are used.
The Ibbotson Bayesian Model (Harvey, 2005)	1999	A hybrid of the global CAPM.
The Beta Approach, the Lambda Approach, and the Bludgeon Approach (Damodaran, 2003a: 63-76; 2003b, 2009a, 2009b)	1999	Country risk premium is added to a) the base premium for mature equity market, b) U.S. market risk premium, or c) CAPM based cost of equity formula for a U.S. company by different measures of country risk.
Estrada's Downside Risk Model (Estrada, 2000: 72-77)	2000	Market risk premium is multiplied by a risk measure instead of the beta factor.
The Adjusted Hybrid CAPM (Pereiro, 2001: 330-370)	2001	Country risk premium is added to the CAPM and an adjusted and modified beta is used.
The Adjusted Local CAPM (Pereiro, 2001: 330-370)	2001	Adjusted beta is used. The cost of equity estimated by the local CAPM is multiplied by the variance of equity volatility of the target company.
The SalomonSmithBarney Model (Zenner and Akaydin, 2002; Pereiro, 2006: 160-183)	2002	Country risk premium is added to the CAPM and an adjusted beta is used.
The Modified International CAPM (Sabal, 2004: 155-166)	2002	It uses weighted beta value when the company concerned operates in more than one country.
The Implied Cost of Capital Model (Damodaran, 2003b; Lee et al., 2003, 2009: 307-335)	2003	Its methodology is similar to the Gordon Growth Model. The model is based on calculating the cost of equity capital, which makes the present value of the forecasts of cash flows or dividends to the equity holders equal to the market price of the relevant common stock. Country risk premium is implicitly considered.

Appendix 7

Descriptive statistics of comparative analysis of estimated and actual used investment costs in the IPs (prepared according to (Jasiukevicius & Vasiliauskaite, 2015a))

Table 1. Descriptive statistics

Gr.	N	Dist	Min	Max	Avg	St. Dev	Kurtosis		Excess		Quantiles		
	Stat.	Stat.	Stat.	Stat.	Stat.	Stat.	Stat.	Error	Stat.	Error	25%	50%	75%
GS	853	3,32	0,75	3,98	1,256	0,6172	2,482	0,084	5,882	0,167	0,993	1	1,2105
A1	1	0	1,89	1,89	1,889	-	-	-	-	-	1,889	1,889	1,889
A2	2	0,005	0,995	1	0,997	3,54E-03	-	-	-	-	-	2,5E-03	-
A3	564	3,23	0,75	3,98	1,287	0,613	2,189	0,103	4,556	0,205	0,992	1	1,364
A4	259	3,22	0,75	3,97	1,185	0,604	3,23	0,151	9,882	0,302	0,995	1	1
A5	4	1,5	1	2,5	1,471	0,709	1,641	1,014	2,537	2,619	1	1,1925	2,221
A5*	27	2,902	0,765	3,667	1,263	,749	2,491	0,448	5,424	0,872	0,898	1	1,048
A6*	823	3,22	0,75	3,98	1,255	0,613	2,489	0,085	5,958	0,17	0,994	1	1,217
A7	23	2,9	0,77	3,67	1,227	0,765	2,752	0,481	6,717	0,935	0,884	1	1,045

GS - General sample; A1 - Land; A2 - Real estate; A3 - Construction, major repairs and other repairs; A4 - Equipment and machineries and other assets; A5 - Projection, technical maintenance and other services related with investment into A1-A4; A5* - Projection, technical maintenance and other services related with investment into A1-A4, (A5 and A7); A6* - Reinvestments (A3 and A4); A7 - Other services.

Table 2. Results of the Mann-Whitney U test

Gr.	CF	N	Avg.	A1	A2	A3	A4	A5	A5*	A6	A7
A1	Land	1	1,889	-	0,221	0,209	0,133	0,468	0,234	0,184	0,216
A2	Real estate	2	0,997	0,221	-	0,504	0,636	0,140	0,662	0,545	0,840
A3	Construction, major repairs and other repairs	564	1,287	0,209	0,504	-	**0,004**	0,283	0,357	0,208	0,152
A4	Equipment and machineries and other assets	259	1,185	0,133	0,636	**0,004**	-	0,086	0,895	0,038	0,586
A5	Projection, technical maintenance and other services related with investment into A1-A4	4	1,471	0,468	0,140	0,283	0,086	-	-	0,204	0,146
A5*	Projection, technical maintenance and other services related with investment into A1-A4, (A5 and A7)	27	1,263	0,234	0,662	0,357	0,895	-	-	0,553	0,679
A6	Reinvestments (A3 and A4)	823	1,255	0,184	0,545	0,208	0,038	0,204	0,553	-	0,243
A7	Other services	23	1,227	0,216	0,840	0,152	0,586	0,146	0,679	0,243	-

Appendix 8

TOP 5 theoretical PDs statistically the most suitable to define the Risk in the pubic IPs (prepared according to (Jasiukevicius & Vasiliauskaite, 2015a))

Gr	Pr. grupė	1st		2nd		3rd		4th		5th	
		PD	Dist	PD	Dist	PD	Dist	PD	Dist	PD	Dist
	General sample	Cauchy	0,219	Gen. Pareto	0,231	Log-Pearson 3	0,237	Erlang	0,250	Log-Logistic (3P)	0,253
A3	Construction, major repairs and other repairs	Erlang (3P)	0,202	Gen. Pareto	0,208	Beta	0,212	Log-Pearson 3	0,222	Log-Logistic (3P)	0,222
A4	Equipment and machineries and other assets	Cauchy	0,257	Gen. Pareto	0,287	Gen. Extreme value	0,300	Log-Logistic (3P)	0,326	Log-Pearson 3	0,329
A5*	Projection, technical maintenance and other services related with investment into A1-A4, (A5 and A7)	Burr (4P)	0,198	Log-Logistic (3P)	0,201	Dagum (4P)	0,206	Gen. Extreme Value	0,210	Frechet (3P)	0,217
A6	Reinvestments (A3 and A4)	Cauchy	0,224	Gen. Pareto	0,235	Log-Pearson 3	0,239	Erlang	0,254	Log-Logistic (3P)	0,256
A7	Other services	Cauchy	0,190	Log-Logistic (3P)	0,205	Burr (4P)	0,207	Gen. Extreme Value	0,211	Dagum (4P)	0,213

The list of theoretical PDs statistically the most suitable to define the Risk in the general sample of IPs

PD	Statistic	Rank	PD	Statistic	Rank
Cauchy	0,219	1	Kumaraswamy	0,322	32
Gen. Pareto	0,231	2	Log-Logistic	0,324	33
Log-Pearson 3	0,237	3	Pearson 5	0,328	34
Erlang	0,250	4	Lognormal	0,330	35
Log-Logistic (3P)	0,253	5	Gen. Gamma	0,331	36
Gen. Extreme Value	0,262	6	Normal	0,332	37
Dagum (4P)	0,262	7	Power Function	0,339	38
Frechet (3P)	0,264	8	Fatigue Life	0,340	39
Inv. Gaussian	0,264	9	Logistic	0,349	40
Pearson 6 (4P)	0,265	10	Weibull	0,353	41
Pearson 5 (3P)	0,265	11	Hypersecant	0,363	42
Pareto	0,267	12	Nakagami	0,368	43
Gen. Gamma (4P)	0,267	13	Dagum	0,373	44
Frechet	0,269	14	Error	0,391	45
Rice	0,270	15	Laplace	0,391	46
Lognormal (3P)	0,273	16	Pert	0,392	47
Burr (4P)	0,274	17	Gumbel Min	0,394	48
Exponential (2P)	0,276	18	Rayleigh (2P)	0,399	49
Weibull (3P)	0,276	19	Levy	0,442	50
Rayleigh	0,279	20	Exponential	0,449	51
Gamma	0,279	21	Pareto 2	0,452	52
Inv. Gaussian (3P)	0,281	22	Reciprocal	0,498	53
Gumbel Max	0,284	23	Triangular	0,524	54
Fatigue Life (3P)	0,297	24	Chi-Squared	0,613	55
Uniform	0,297	25	Error Function	0,887	56
Beta	0,302	26	Chi-Squared (2P)	No fit	
Gamma (3P)	0,302	27	Erlang (3P)	No fit	
Johnson SB	0,302	28	Johnson SU	No fit	
Levy (2P)	0,309	29	Log-Gamma	No fit	
Burr	0,310	30	Student's t	No fit	
Pearson 6	0,320	31			

Appendix 9

Checklist of risk factors identified in the PPP IPs, (prepared according to Ernest Effah; Ameyaw & Chan (2015); Chou et al. (2012); Chung et al. (2010); Hwang et al. (2013); Ke et al. (2010); Martins et al. (2011); A. Ng & Loosemore (2007); Li Yin Shen et al. (2006))

ID	Risk factor	Definition
1	Corruption	Corrupt local government officials demand bribes or unjust rewards
2	Government's intervention	Public sector interferes unreasonably in privatized facilities/services
3	Expropriation and nationalization	Due to political, social or economic pressures, local government takes over the facility run by private firm without giving reasonable compensation
4	Government's reliability	The reliability and creditworthiness of the government to be able and willing to honor their obligations in future
5	Third party reliability	The reliability and creditworthiness of a third party to be able and willing to honor their obligations in future
6	Public/political opposition	Prejudice from public due to different local living standards, values, culture, social system, etc.
7	Immature juristic system	The lack of national PPP law leads to different ways of PPP implementation
8	Change in law	Local government's inconsistent application of new regulations and laws
9	Interest rate	Unanticipated local interest rate changes due to immature local economic and banking systems
10	Foreign exchange and convertibility	Fluctuation in currency exchange rate and/or difficulty of convertibility
11	Inflation	Unanticipated local inflation rate due to immature local economic and banking systems
12	Poor political decision-making	Government officials considers more their career achievement or short-term goals or personal interests, or with little PPP experience etc., resulting in a poor political decision-making process
13	Land acquisition	The project land is unavailable, or unable to be occupied at the required time
14	Approval and permit	Delay or refusal of project approval and permit by local government
15	Improper contracts	Improper arrangements in the contracts including inappropriate risk allocation among stakeholders, commitment from public/private partners
16	Financing risk	Poor financial market or unavailability of financial instrument resulting difficulty of financing
17	Construction changes	Unanticipated changes and errors in the construction resulting from the improper design or poor investigation
18	Operation changes	Unanticipated changes and errors in the operation resulting from the improper design or poor investigation

19	Construction completion	Longer construction time than predicted, Construction cost overrun or poor construction quality
20	Delay in supply	Subcontractors and suppliers not being able to supply labor or material on time
21	Technology risk	The technology adopted not being mature or able to meet the requirements
22	Ground/weather conditions	Poor or unexpected ground/weather conditions
23	Operation cost overrun	Operation cost overrun resulting from improper measurement, ill planned schedule or low operation efficiency
24	Competition (exclusive right)	The government does not offer the exclusive right, or does not honor to its commitment and build another competitive project
25	Market demand change	Demand change from other factors, i.e. social, economic, etc., except the exclusive right
26	Tariff change	Improper tariff design or inflexible adjustment framework leading to the insufficient income
27	Payment risk	The government not being able or willing to pay, due to social or other reasons
28	Supporting utilities risk	Supporting utilities, such as electricity, water, necessary for the construction, operation and management would not be available in a timely manner or at fair rates
29	Residual assets risk	Assets transferred to the government at the end of the concession period would not be normally running
30	Uncompetitive tender	The tendering process and documents vary from project to project and from province to province in China without transparent or standardized models
31	Consortium inability	The consortium not being able to perform its obligations as a PPP project company
32	Force majeure	The circumstances that are out of the control of both foreign and local partners, such as flood, fires, storms, epidemic diseases, war, hostilities and embargo
33	Organization and coordination risk	An increase of transaction cost or a dispute may occur because of the improper organization and coordination
34	Tax regulation changes	Central or local government's inconsistent application of the tax regulation
35	Environmental protection	Stringent regulation which will have an impact on construction firms' poor attention to environmental issues
36	Private investor change	Due to the disputes among private investors or other reasons, one or some investors exit/enter the consortium
37	Subjective evaluation	Subjective evaluation and design of the concession period, tariff structure, market demand, etc.
38	Insufficient financial audit	The government/lenders would not perform a careful audit to the financial status of the project company
39	Improper design	Improper design resulting in higher cost of operation and maintenance
40	Design fault in tender specifications	Improper design specification resulting in proposals which do not meet the needs

41	Site safety and security	Site does not comply with health and safety law
42	Construction cost overrun	Construction cost overrun resulting from improper measurement, ill planned schedule or low operation efficiency
43	Maintenance cost overrun	Maintenance cost overrun resulting from improper design, low quality materials installed or higher than expected load
44	Inadequate distribution of responsibilities	Responsibilities are distributed between entities above their abilities to manage risks in the most efficient way
45	Failure to meet performance criteria	Project fails to meet performance criteria at the predetermined costs
46	Inadequate distribution of authority	Distributed authorities are insufficient to meet efficiency goals or give possibilities to abuse
47	Lack of commitment of between parties	Entities do not comply with the contract
48	Differences in working method	Incompatibility between entities' working methods resulting in negative effect on the project or its failure
49	Excessive contract variation	Difficulties to control responsibilities of entities
50	Financial attraction of project to investors	Project return is insufficient to attract investors to participate
51	Scope variation	Difficulties to determine risk and responsibilities of entities as well as total cost of projects
52	Insufficient income	Income are lower than expected and, therefore, requires additional financing
53	Fluctuation of material cost	Changes of material price in the market causing the requirement for additional financing
54	Operator default	Bankruptcy of operator
55	Influential economic events	Loss caused by economic or financial crisis
56	Insolvency of subcontractors	Subcontractors are not able to apply the undertakings
57	Quality risk	It is not satisfied the predetermined quality standards
58	Availability of labor/materials	Difficulties to find labor and material of appropriate quality, quantity and qualification accordingly
59	Labor disputes and strikes	Interruption of performance due to labor disputes and strikes
60	Land use	Legal issues to use particular land for implementation of project
61	Waste of materials	Loss caused by inefficiency use of materials
62	Protection of geological and historical objects	Demage on protected objects

63	Archaeologic object	It emerges early unknown restrictions on archaeological and cultural heritage protection requirements
64	Low operating productivity	Outputs are lower than it was planned
65	Asset ownership	Risks associated with ownership of the assets, including the risk that the technology becomes obsolete or that the value of the assets at the end of the contract is different than was expected

Appendix 10

Comparative analysis of preferences of risk allocation from different literature (prepared by the author of this dissertation)

ID	Risk factor	Category	*PPP specific?*	1*	2*	3*	4*	5*	6*	7*	8*	9*	*Same?*	Author preference
1	Corruption	Political	*No*								Pu			Pu
2	Government's intervention	Political	*No*		Pu			Pu	Pu		Pu		Yes	Pu
3	Expropriation and nationalization	Political	*No*		Po	Pu		Pu	Pu		Pu		No	Pu
4	Government's reliability	Political	*No*	Pu	Pu						Pu		Yes	Pu
5	Third party reliability	Legal	*No*	Pu		Pr					Sh		No	Pu
6	Public/political opposition	political	*No*								Sh			Pu
7	Immature juristic system	Legal	*Yes*								Pu			Pu
8	Change in law	Political	*No*	Sh	Pr	Sh	Sh	Sh	Sh	Pu	Pu	Pr	No	Pr or Pu[1]
9	Interest rate	Economic	*No*		Sh	Pr		Sh	Pr		Sh	Pr	No	Pr
10	Foreign exchange and convertibility	Economic	*No*					Pu	Pr		Sh	Pr	No	Pr
11	Inflation	Construction	*No*	Sh	Sh	Pr	Pr	Sh	Sh	Sh	Sh		No	Pr
12	Poor political decision-making	Political	*No*								Pu			Pu
13	Land acquisition	Political	*No*								Pu			Pu
14	Approval and permit	Political	*No*	Pr	Sh		Sh			Pr	Pu	Pu	No	Pu or Pr[2]
15	Improper contracts	Legal	*No*								Sh	Pu	No	Pu
16	Financial risk	Economic	*No*		Pr	Pr	Pr			Pr	Pr		Yes	Pr
17	Construction changes	Construction	*No*	Pr	Pu				Pu	Pu	Pr		No	Pr
18	Operation changes	Operation	*No*	Pr	Pu				Pu	Pu	Pr		No	Pr

19	Construction completion	Construction	*No*	Pr	Pr	Pr	Pr	Pr	Pr	Pr	Pr	Pr	Yes	Pr
20	Delay in supply	Construction	*No*								Pr			Pr
21	Technology risk	Construction	*No*			Pr	Sh		Sh	Pr	Pr		No	Pr
22	Ground/weather conditions	Construction	*No*	Pu	Pr	Pr				Pr	Sh		No	Pr
23	Operation cost overrun	Operation	*No*		Pr	Pr	Pr		Pr		Pr	Pr	Yes	Pr
24	Competition (exclusive right)	Market	*No*								Pu			Pu
25	Market demand change	Market	*No*		Pr	Pr	Sh	Pr	Sh		Sh		No	Pr or Sh[3]
26	Tariff change	Market	*No*		Pr	Pr		Pr	Pr	Pr	Sh	Pr	No	Pr
27	Payment risk	Market	*No*								Sh			Pu
28	Supporting utilities risk	Operation	*No*								Pu			Pu
29	Residual assets risk	Residual value	*No*				Pr		Pr	Pu	Pr		No	Pr
30	Uncompetitive tender	Legal	*No*								Pu			Pu
31	Consortium inability	Legal	*Yes*								Pr			Pr
32	Force majeure	Other	*No*		Sh	Sh	Sh		Sh	Sh	Sh		Yes	Sh
33	Organization and coordination risk	Legal	*No*								Pr			Pr
34	Tax regulation changes	Political	*No*								Pu		Yes	Pr or Pu[4]
35	Environmental protection	Construction	*No*								Sh	Pr	Yes	Pr
36	Private investor change	Legal	*Yes*								Pr			Pu
37	Subjective evaluation	Legal	*No*								Sh			Pu
38	Insufficient financial audit	Legal	*No*								Sh			Pu
39	Improper design	Design	*No*	Pr	Pr	Pr	Pr	Pr	Pr	Pr		Pr	Yes	Pr
40	Design fault in tender specifications	Legal	*No*									Pu	Yes	Pu
41	Site safety and security	Construction	*No*	Pr			Pr						Yes	Pr
42	Construction cost overrun	Construction	*No*	Pr	Pr	Pr	Pr	Pr	Pr	Pr		Pr	Yes	Pr

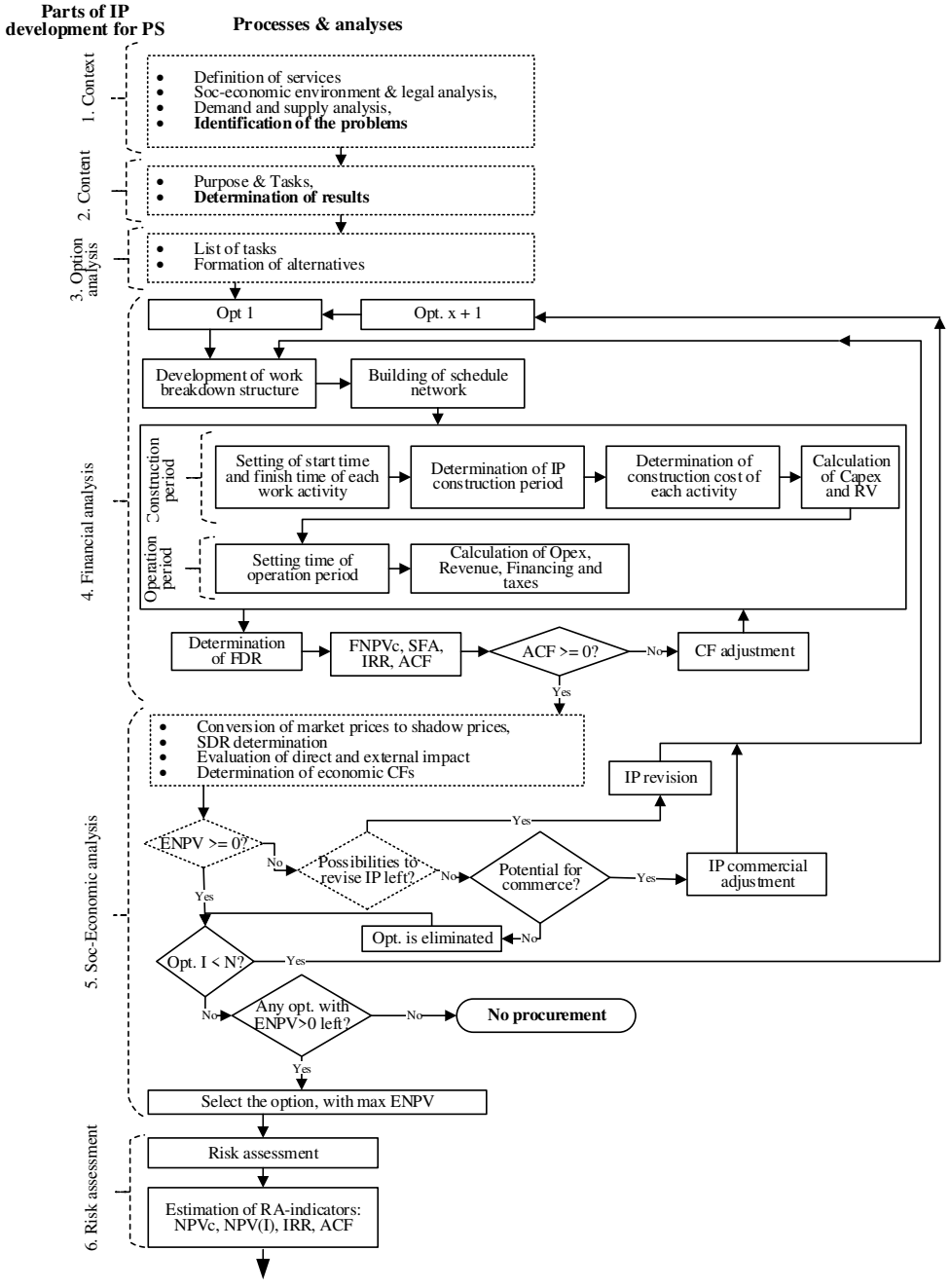
43	Maintenance cost overrun	Operation	*No*			Pr	Pr		Pr	Pr			Yes	Pr
44	Inadequate distribution of responsibilities	Legal	*No*											Pu
45	Failure to meet performance criteria	Operation	*No*									Pr		Pr
46	Inadequate distribution of authority	Legal	*No*											Pu
47	Lack of commitment of between parties	Legal	*No*											Pr or Pu[5]
48	Differences in working method	Operation	*No*											Pr
49	Excessive contract variation	Legal	*No*											Pu
50	Financial attraction of project to investors	Market	*Yes*											Pu
51	Scope variation	Legal	*No*											Pu
52	Insufficient income	Market	*No*			Pr	Pr	Pr						Pr
53	Fluctuation of material cost	Construction	*No*		Pr			Pr	Pr	Pr		Pr	Yes	Pr
54	Operator default	Legal	*No*		Pr		Pr	Pr					Yes	Pr
55	Influential economic events	Market	*No*			Pr				Pr			Yes	Pr
56	Insolvency of subcontractors	Legal	*No*	Pr		Pr	Pr	Pr	Pr				Yes	Pr
57	Quality risk	Operation	*No*	Pr	Pr	Pr	Pr	Pr	Pr	Pr			Yes	Pr
58	Availability of labor/materials	Construction	*No*	Pr		Pr		Pr					Yes	Pr
59	Labor disputes and strikes	Other	*No*	Pr				Pr		Pr			Yes	Pr
60	Land use	Political	*No*		Pu	Pu			Pu				Yes	Pu
61	Waste of materials	Operation	*No*		Pr	Pr	Pr						Yes	Pr
62	Protection of geological and historical objects	Construction	*No*					Pr		Pr			Yes	Pr
63	Archaeologic object	Construction	*No*											Pu
64	Low operating productivity	Operation	*No*			Pr	Pr	Pr	Pr					Pr
65	Asset ownership	Legal	*Yes*											Pu

No	Authors
1*	Lam et al. (2007)
2*	Ng and Loosemore (2007)
3*	Li et al. (2005)
4*	Arndt (1998)
5*	Wang and Tiong (2000)
6*	NTSA (2004)
7*	VDTF (2001)
8*	Ke et al. (2010)
9*	Guasch (2004)

No	RC explanation
1	If it is general law applied for all entities - Pr, if it is specifically applied to PPPs - Pu
2	If the private entity has done its obligation and the public sector is later in its decision - Pu, otherwise - Pr
3	Usually private, but the PPA may provide partial or full guarantees.
4	Usually private, but in a case of VAT tax - public
5	Depending on the PPP contract

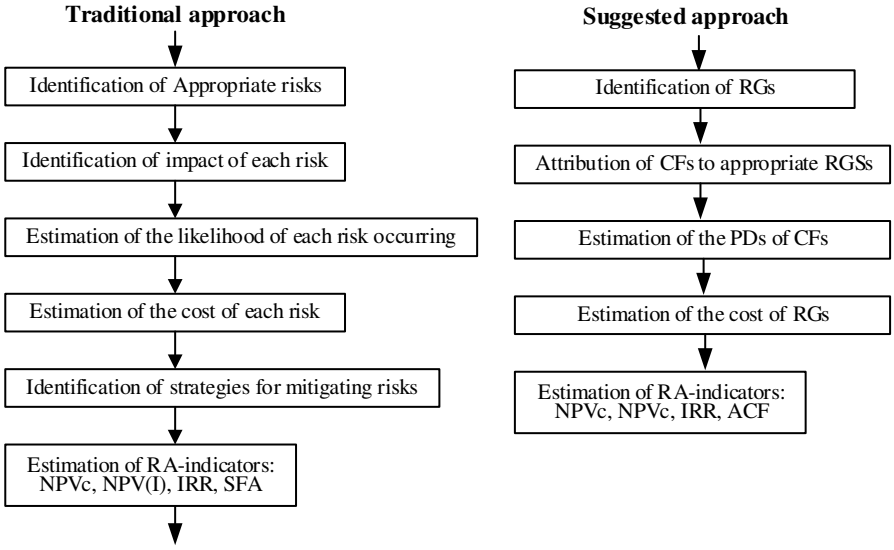
Appendix 11

The model: Stage 1: preparation of the initial IP (prepared by the author of this dissertation)



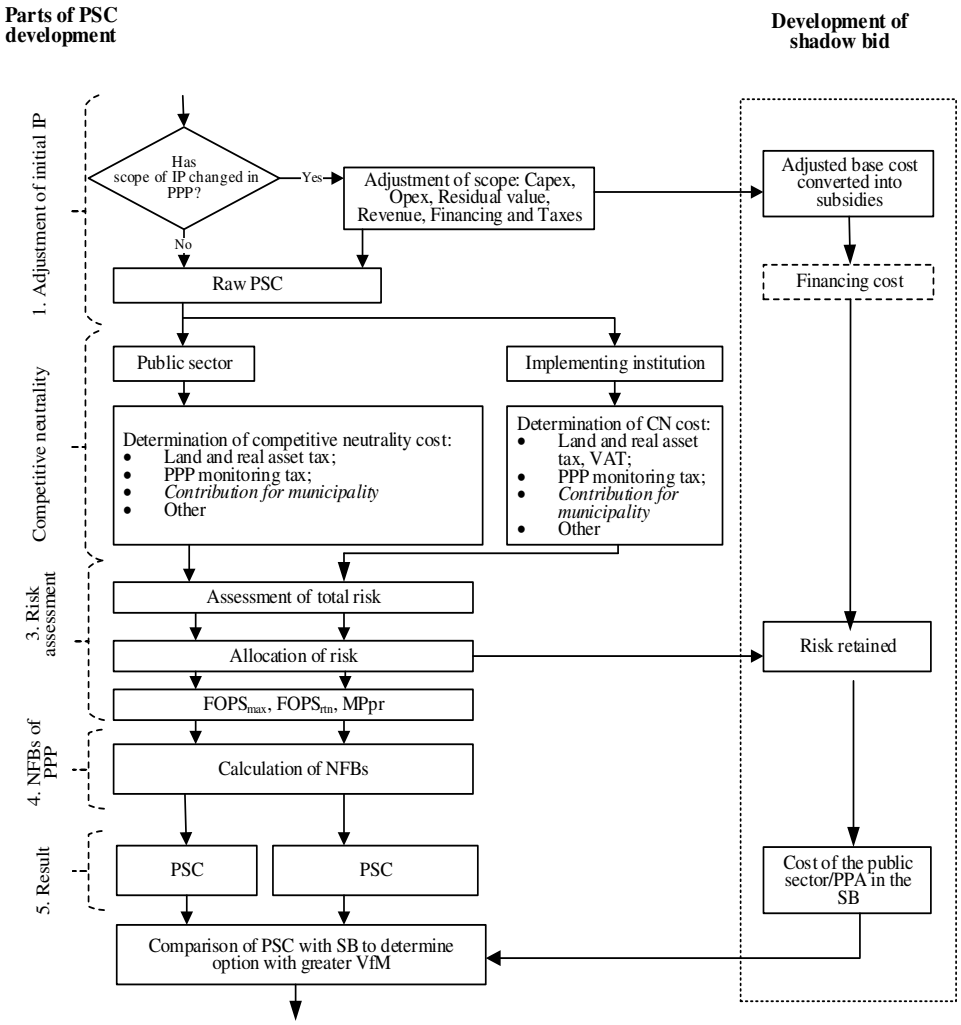
Appendix 12

The model: Stage 1: preparation of the initial IPs: Approaches to Risk assessment (prepared by the author of this dissertation)



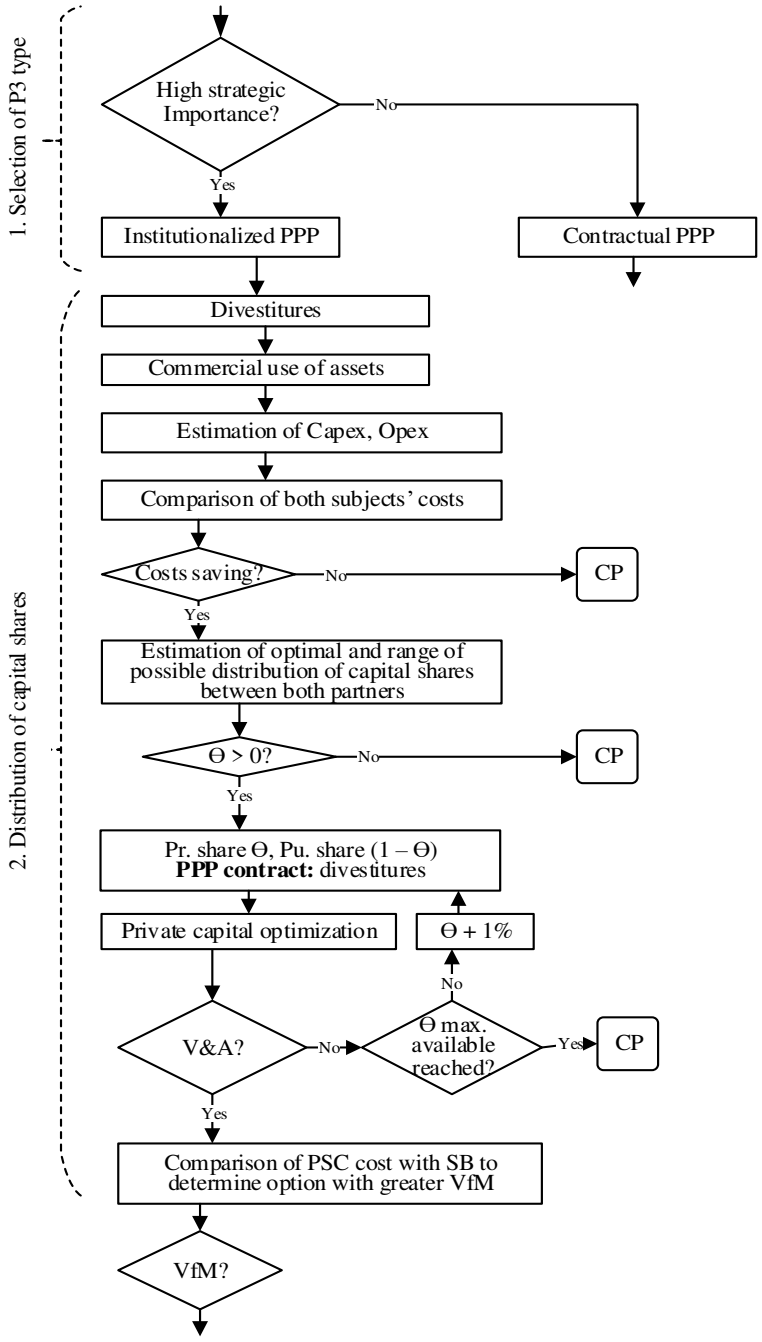
Appendix 13

The model: Stage 3: PPP feasibility analysis: development of the PSC
(prepared by the author of this dissertation)



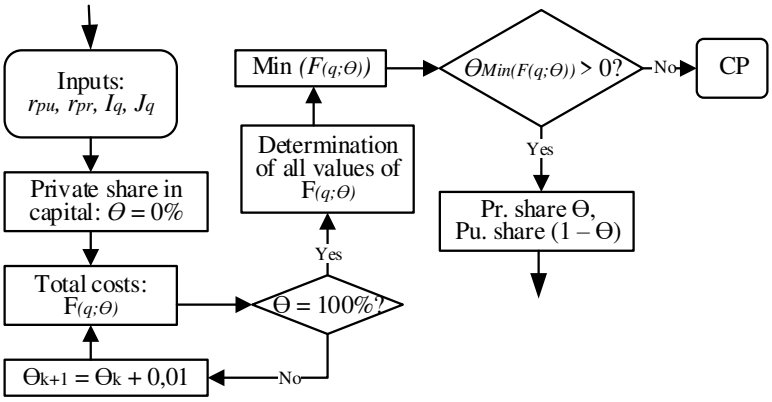
Appendix 14

The model: stage 3: PPP feasibility analysis: Institutional PPP development (prepared by the author of this dissertation)



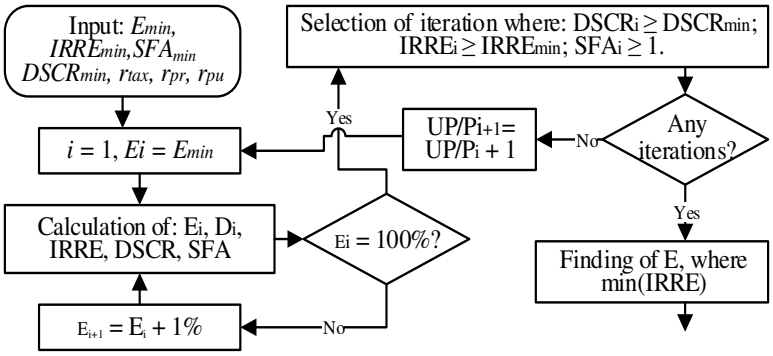
Appendix 15

The model: stage 3: PPP feasibility analysis: Institutional PPP development: Optimal share of public and private capital (prepared by the author of this dissertation)



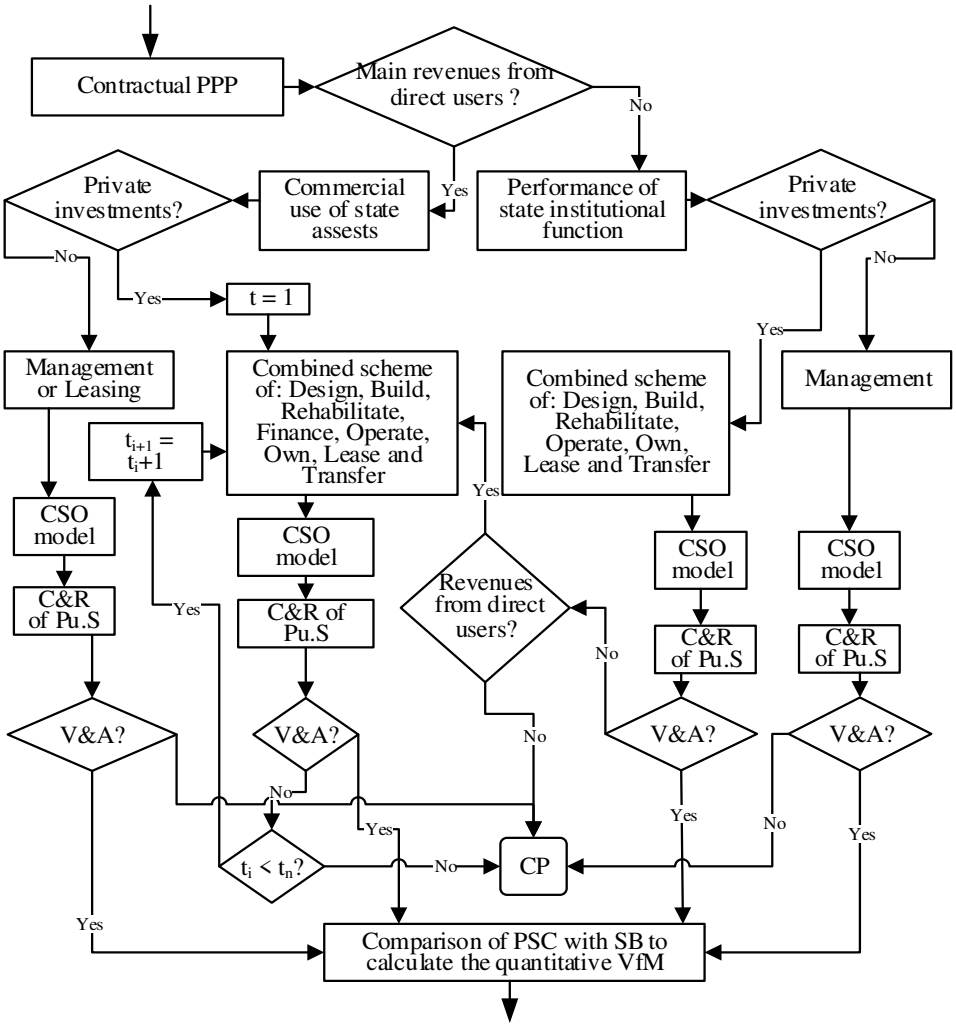
Appendix 16

The model: stage 3: PPP feasibility analysis: Institutional PPP development: Capital structure optimization (prepared by the author of this dissertation)



Appendix 17

The model: stage 3: PPP feasibility analysis: Institutional PPP development: Contractual PPP development (prepared by the author of this dissertation)



Appendix 18

Calculation of the FDR based on the CAPM approach (prepared by the author of this dissertation)

Country	Code	National security market index	Classification: Dow Jones, MSCI	Risk-free rate: US 10y bond yields)	S&P100 Global (10-y return rate)	St. Dev. σ_l	Corr (r_l,r_g)	S&P100 Global: σ_g	Moody's rating	Rating-based default spread	β	FDR
Sweden	SWE	OMXS30	D	2,82%	4,91%	4,85%	63,43%	4,74%	Aaa	0,00%	0,65	4,18%
Denmark	DEN	OMXC20	D	2,82%	4,91%	5,54%	59,08%	4,74%	Aaa	0,00%	0,69	4,26%
United Kingdom	UK	FTSE100	D	2,82%	4,91%	4,06%	87,62%	4,74%	Aa1	0,46%	0,75	4,39%
Finland	FIN	OMXH25	D	2,82%	4,91%	5,77%	62,09%	4,74%	Aa1	0,46%	0,75	4,40%
Ireland	IRE	ISEQ	D	2,82%	4,91%	6,20%	61,82%	4,74%	A3	1,39%	0,81	4,51%
Portugal	POR	PSI20	D	2,82%	4,91%	5,76%	68,38%	4,74%	Ba1	2,89%	0,83	4,56%
Belgium	BEL	BEL20	D	2,82%	4,91%	4,97%	79,80%	4,74%	Aa3	0,70%	0,84	4,57%
Netherlands	NL	AEX	D	2,82%	4,91%	5,34%	80,86%	4,74%	Aaa	0,00%	0,91	4,72%
France	FRA	CAC40	D	2,82%	4,91%	5,06%	87,00%	4,74%	Aa2	0,57%	0,93	4,76%
Germany	GER	DAX	D	2,82%	4,91%	5,63%	82,85%	4,74%	Aaa	0,00%	0,98	4,88%
Spain	SPA	IBEX35	D	2,82%	4,91%	6,04%	78,74%	4,74%	Baa2	2,20%	1,00	4,92%
Luxembourg	LUX	LUXX	D	2,82%	4,91%	7,54%	66,52%	4,74%	Aaa	0,00%	1,06	5,03%
Italy	ITA	FTSEMIB	D	2,82%	4,91%	6,51%	79,52%	4,74%	Baa2	2,20%	1,09	5,10%
Austria	AST	ATX	D	2,82%	4,91%	6,74%	80,60%	4,74%	Aa1	0,46%	1,15	5,21%
Czech Republic	CZR	PX	E	2,82%	4,91%	6,37%	73,36%	4,74%	A1	0,81%	0,81	5,31%
Poland	POL	WIG20	E	2,82%	4,91%	6,02%	73,52%	4,74%	A2	0,98%	0,76	5,39%
Hungary	HUN	BUX	E	2,82%	4,91%	6,83%	73,72%	4,74%	Baa3	2,54%	0,86	7,17%

Greece	GRE	ATG	E	2,82%	4,91%	9,74%	71,67%	4,74%	Caa3	11,55%	1,23	16,94%
Slovakia	SLK	SAX	F	2,82%	4,91%	4,22%	26,61%	4,74%	A2	0,98%	0,53	4,91%
Malta	MAL	MALTEX	F	2,82%	4,91%	5,66%	59,77%	4,74%	A3	1,39%	0,72	5,71%
Estonia	EST	OMXT	F	2,82%	4,91%	8,21%	36,07%	4,74%	A1	0,81%	1,04	5,80%
Latvia	LAT	OMXR	F	2,82%	4,91%	6,44%	28,89%	4,74%	A3	1,39%	0,81	5,91%
Lithuania	LIT	OMXV	F	2,82%	4,91%	7,36%	40,10%	4,74%	A3	1,39%	0,93	6,16%
Slovenia	SLO	SBITOP	F	2,82%	4,91%	5,74%	42,44%	4,74%	Baa3	2,54%	0,73	6,88%
Bulgaria	BUL	SOFIX	F	2,82%	4,91%	8,36%	53,32%	4,74%	Baa2	2,20%	1,06	7,23%
Romania	ROM	BET	F	2,82%	4,91%	8,78%	71,00%	4,74%	Baa3	2,54%	1,11	7,68%
Croatia	CRO	CRBEX	F	2,82%	4,91%	7,27%	58,09%	4,74%	Ba2	3,47%	0,92	8,21%
Cyprus	CYP	CYFT20	F	2,82%	4,91%	13,00%	52,10%	4,74%	B1	5,20%	1,64	11,46%

Appendix 19

Key inputs of the hypothetical IP (the revenue generating model) (prepared by the author of this dissertation)

Economic data

2,00%	Inflation rate for everything except expense of energy, water and waste disposal	
3,00%	Inflation rate for expense of energy, water and waste disposal	
0,00%	Interest rate earned on cash deposits	
1	Is the indexation applied in Public Sector Model?	<<< Enter 0 for non-application; Enter 1 for application
NOMINAL PRICES		

1	Income received?	<<< Enter 1 (TRUE) or 0 (FALSE)

Taxes

21,00%	**VAT**	
1	Possibility to recover VAT	<<< Enter 1 (TRUE) or 0 (FALSE)
15,00%	**Profit tax**	
1	PSC: Profit tax for the public sector company applied?	<<< Enter 1 (TRUE) or 0 (FALSE)
0	Tax Holiday (year tax holiday ends)	
0	PPP: Nonprofit organization (NPO) // non-business entity?	<<< Enter 1 (Nonprofit) or 0 (business entity)
0	Allow Tax Holiday?	<<< Enter 1 (TRUE) or 0 (no tax holiday)
5	Tax Holiday (year tax holiday ends)	

1,00%	**Real estate tax**	
0	Allow Tax Holiday?	<<< Enter 1 (TRUE) or 0 (no tax holiday)
26	Tax Holiday (year tax holiday ends)	

0,40%	**Land tax**	
1 500 000	Base for land tax (€)	
6 000	Land rent tax per year (€)	
16	Land rent tax per day (€)	
0	Allow land tax holiday?	<<< Enter 1 (TRUE) or 0 (no tax holiday)
26	Tax Holiday (year tax holiday ends)	

0	Require contribution for manucipality?	<<< Enter 1 (TRUE) or 0 (no contribution for municipality required)
1 500 000	**Contribution for manucipality**	

45 000	**PPP contract implementation monitoring tax per year (€ per unit without VAT)**	
123	PPP contract implementation monitoring tax per day (€ per unit without VAT)	
1	Is PPP contract monitoring tax required?	<<< Enter 1 (TRUE) or 0 (no monitoring tax required)

Project schedule

Days for the calculation of costs / income per day

1461	Number of days in period of four years
365,25	Number of days in period of one year
30,44	Number of days in period of one month

Construction period

25	Reference period (number of years)
2016-12-31	Date of financial closure

	Public sector	*PPP*	*Diff. (%)*	
#	150	150	0%	Days needed to complete the design
	0	0	0%	Days of Design completion dalay
	150	150		<<< Design timing is planned well
	2017-05-31	2017-05-31		Date of garage construction begin
#	360	360	0%	Days needed to complete garage (per contract)
	0	0	0%	Days of garage completion delay
	360	360		<<< Construction timing is planned well
	2018-05-26	2018-05-26		Date of installation begin
#	91	91	0%	Days needed to install equipment (per contract)
	0	0	0%	Days of equipment installation delay
	91	91		<<< Equipment instalation timing is planned well
	601	601		Total days in construction period

#

Operation period

Public sector	*PPP*		
2018-08-26	2018-08-26	Date of operation begin	
2041-12-30	2041-12-30	Reference period end day	
8 621	8621	Total days in reference period	
2016-06-01		Base date for all costs and prices used in the model	<<< All costs in later time periods are based on this date and then indexed for inflation

Reinvestments

Public sector	PPP	
2026-08-25	2026-08-25	Data of the reinvestments No. 1 is completed
2034-08-25	2034-08-25	Data of the reinvestments No. 2 is completed

Investments in infrastructure

	Public sector	PPP	Diff. (%)	
#	7000	6300	-10%	Cost (€ per multi-storey parking space without VAT)
	2 400	2400	0%	Number of parking spaces built in multi-storey parking facility
	7	7		Parking spaces per day (€ per multi-level parking space without VAT)
#	1600	1440	-10%	Cost (€ per ground parking space without VAT)
	600	600	0%	Number of parking spaces built in ground parking facility
	2	2		Parking spaces per day (€ per ground parking space without VAT)
#	1,50%	1,4%	-10%	Development fees
#	0,50%	0,5%	-10%	Advisory fees
#	1,50%	1,4%	-10%	Insurance
#	10,00%	9,0%	-10%	Contingency
#	150 000	135 000	-10%	Design cost (€)
	1 000	900		Design cost (€) per day

Parking equipment

	Public sector	PPP	Diff. (%)	
#	3 260	2 934	-10%	ANPR camera for charge (€ per unit without VAT)
	3	3	0%	Number of ANPR cameras for charge
#	1 290	1 161	-10%	Road gate (€ per unit without VAT)
	6	6	0%	Number of road gate
#	14 480	13 032	-10%	Payment desk (€ per unit without VAT)
	6	6	0%	Number of payment payment desk
#	145	131	-10%	Intercom (€ per unit without VAT)
	8	8	0%	Number of Intercom
#	5 890	5 301	-10%	Information board in front of the parking facility (€ per unit without VAT)
	3	3	0%	Number of Information board in front of the parking facility
#	8 680	7 812	-10%	Software (€ without VAT)
	1	1	0%	Number of software
#	0,15	14%	-10%	Instalation and adjustment, coefficient from the estimate of parking equipment
	1450	1305		Equipment cost (€) per day

Renewal and reinvestments of parking equipment

Public sector	PPP	
131 910	118 719	Cost (€) of reinvestment
19 787	16 027	Cost (€) of reinvestment instalation and adjustment

Amortization and depreciation

Norms for the public sector model applied

1	Depreciation norms applied for parking plots

<<< where 0 is norms of the public sector, 1 - the private sector

Norms for the both of sectors' model applied

Norms of sector		
Public	Private	
60	15	Depreciation period for garage (years)
21 915	5 479	Days depreciation period for garage
8	5	Depreciation period for equipment (years)
2 922	1 826	Days depreciation period for equipment

<<< adjuested for the concesion period calculation if needed

<<< adjuested for the concesion period calculation if needed

Procurement and oversight

Total investments

	Public sector	PPP	Diff. (%)	
#	50 000	100 000	100%	Procurement cost

Operation expenditure

Infrastructure maitenance costs

	Public sector	PPP	Diff. (%)	
#	120	108	-10%	Cost of medium repair per parking space (capital investments € without VAT)
#	350	315	-10%	Cost of major repair per parking space (capital investment € without VAT)
	13	13		Project year of medium maitenance needed
	0	0		Project year of medium repair needed
	20	20		Project year of major maitenance needed

Energy

#	0,12	Electric energy tariff (without VAT), €/kWh
#	0,09	Heating energy tariff (without VAT), €/kWh
#	0,79	Drinking water and wastewater treatment tariff (without VAT), €/m3

Fixed costs of services

	Public sector	PPP	Diff. (%)	
#	4 200	3 780	-10%	System maitenance services per month (€ per unit without VAT)
	138	124		System maitenance services per day (€ per unit without VAT)
#	580	522	-10%	Accounting services per month (€ per unit without VAT)
	19	17		Accounting services per day (€ per unit without VAT)
#	7 000	6 300	-10%	Audit services per year (€ per unit without VAT)
	19	17		Audit services per day (€ per unit without VAT)
#	15 000	13 500	-10%	Insurance services per year (€ per unit without VAT)
	41	37		Insurance services per day (€ per unit without VAT)
#	1 100	990	-10%	Calling center serices per month (€ per unit without VAT)
	36	33		Calling center serices per day (€ per unit without VAT)
#	2 000	1 800	-10%	Asset management tax per month (€ per unit without VAT)
	66	59		Asset management tax per day (€ per unit without VAT)

Viriable costs of services

	Public sector	PPP	Diff. (%)	
#	0,06	0,054	-10%	Costs of sand and oil trap services for one parking space per month (€ per unit without VAT)
	0,002	0,002		Costs of sand and oil trap services for one parking space per day (€ per unit without VAT)
#	1,45	1,305	-10%	Costs of permanent repair for one parking space per month (€ per unit without VAT)
	0,048	0,043		Costs of permanent repair for one parking space per day (€ per unit without VAT)
#	0,1	0,090	-10%	Maitenance of equipment of one parking space per month (€ per unit without VAT)
	0,003	0,003		Maitenance of equipment of one parking space per day (€ per unit without VAT)
#	3,000	2,700	-10%	Cleannig services for one parking space per month (€ per unit without VAT)
	0,099	0,089		Cleannig services for one parking space per day (€ per unit without VAT)
#	0,030	0,027	-10%	Wastewater treatment m3 for one parking space per month
	0,001	0,001		Wastewater treatment m3 for one parking space per day
#	15,000	13,500	-10%	Average heat cunsumptions kWh per day
#	2 100	1 890	-10%	Electricity energy consumption kWh per day

Salaries

	Public sector	PPP	Diff. (%)	
	4	4,00	0%	Number of working staff
	2	2,00	0%	Number of staff in administration
#	1 000	900	-10%	Costs of job place of one worker (€) per month
	33	30		Costs of job place of one worker (€) per day
#	2 500	2 250	-10%	Costs of job place of one worker in administration (€) per month
	82	74		Costs of job place of one worker in administration (€) per day
#	30 000	27 000	-10%	Other administration expense

Income

1	Income received?

<<< Enter 0 for non-gathering; Enter 1 for gathering

Public sector

Distribution of parking spaces of different pricing availible

P1	P2	P3
10%	5%	85%
300	150	2550

Average number of occupied parking spaces of day parking

P1	P2	P3
45%	5%	65%

Average number of occupied parking spaces of day parking

P1	P2	P3
45%	5%	65%
135	7,5	1657,5

Availible parking spaces left to hourly parking

P1	P2	P3
165	142,5	892,5

PPP

Distribution of parking plots of different pricing availible

P1	P2	P3
10%	5%	85%
300	150	2550

Average number of occupied parking spaces of day parking

P1	P2	P3
45%	5%	65%
135	7,5	1657,5

Availible parking spaces left to hourly parking

P1	P2	P3
165	142,5	892,5

Average occupation of parking spaces of hourly parking

Hour	P1	P2	P3
0 - 1 val.	40%	10%	10%
1 - 2 val.	15%	5%	10%
2 - 3 val.	10%	5%	10%
3 - 4 val.	10%	5%	10%
4 - 5 val.	10%	5%	10%
5 - 6 val.	20%	5%	10%
6 - 7 val.	50%	5%	10%
7 - 8 val.	60%	10%	10%
8 - 9 val.	60%	15%	10%
9 - 10 val.	40%	15%	10%
10 - 11 val.	30%	15%	10%
11 - 12 val.	40%	20%	10%
12 - 13 val.	50%	20%	10%
13 - 14 val.	70%	20%	10%
14 - 15 val.	60%	15%	10%
15 - 16 val.	50%	15%	10%
16 - 17 val.	50%	15%	10%
17 - 18 val.	50%	15%	10%
18 - 19 val.	50%	20%	10%
19 - 20 val.	50%	20%	10%
20 - 21 val.	70%	20%	10%
21 - 22 val.	60%	15%	10%
22 - 23 val.	50%	10%	10%
23 - 24 val.	50%	10%	10%
Average	44%	13%	10%

Average occupation of parking spaces of hourly parking

Hour	P1	P2	P3
0 - 1 val.	40%	10%	10%
1 - 2 val.	15%	5%	10%
2 - 3 val.	10%	5%	10%
3 - 4 val.	10%	5%	10%
4 - 5 val.	10%	5%	10%
5 - 6 val.	20%	5%	10%
6 - 7 val.	50%	5%	10%
7 - 8 val.	60%	10%	10%
8 - 9 val.	60%	15%	10%
9 - 10 val.	40%	15%	10%
10 - 11 val.	30%	15%	10%
11 - 12 val.	40%	20%	10%
12 - 13 val.	50%	20%	10%
13 - 14 val.	70%	20%	10%
14 - 15 val.	60%	15%	10%
15 - 16 val.	50%	15%	10%
16 - 17 val.	50%	15%	10%
17 - 18 val.	50%	15%	10%
18 - 19 val.	50%	20%	10%
19 - 20 val.	50%	20%	10%
20 - 21 val.	70%	20%	10%
21 - 22 val.	60%	15%	10%
22 - 23 val.	50%	10%	10%
23 - 24 val.	50%	10%	10%
Average	44%	13%	10%

Average number of occupied parking spaces of hourly parking

0 - 1 val.	66	14	89
1 - 2 val.	25	7	89
2 - 3 val.	17	7	89
3 - 4 val.	17	7	89
4 - 5 val.	17	7	89
5 - 6 val.	33	7	89
6 - 7 val.	83	7	89
7 - 8 val.	99	14	89
8 - 9 val.	99	21	89
9 - 10 val.	66	21	89
10 - 11 val.	50	21	89
11 - 12 val.	66	29	89
12 - 13 val.	83	29	89
13 - 14 val.	116	29	89
14 - 15 val.	99	21	89
15 - 16 val.	83	21	89
16 - 17 val.	83	21	89
17 - 18 val.	83	21	89
18 - 19 val.	83	29	89
19 - 20 val.	83	29	89
20 - 21 val.	116	29	89
21 - 22 val.	99	21	89
22 - 23 val.	83	14	89
23 - 24 val.	83	14	89
Average	72	18	89

Average number of occupied parking spaces of hourly parking

0 - 1 val.	66	14	89
1 - 2 val.	25	7	89
2 - 3 val.	17	7	89
3 - 4 val.	17	7	89
4 - 5 val.	17	7	89
5 - 6 val.	33	7	89
6 - 7 val.	83	7	89
7 - 8 val.	99	14	89
8 - 9 val.	99	21	89
9 - 10 val.	66	21	89
10 - 11 val.	50	21	89
11 - 12 val.	66	29	89
12 - 13 val.	83	29	89
13 - 14 val.	116	29	89
14 - 15 val.	99	21	89
15 - 16 val.	83	21	89
16 - 17 val.	83	21	89
17 - 18 val.	83	21	89
18 - 19 val.	83	29	89
19 - 20 val.	83	29	89
20 - 21 val.	116	29	89
21 - 22 val.	99	21	89
22 - 23 val.	83	14	89
23 - 24 val.	83	14	89
Average	72	18	89

0,50000	Price viriable	0,00%	Change of the price level

Simulation. Coefficients

Duration	P1	P2	P3
Hourly-parking	2,5	3,5	2
Day-parking	17,4	17,4	6,1

Simulation. Prices without VAT

Duration	P1	P2	P3
Hourly-parking	1,03	1,45	0,83
Day-parking	7,19	7,19	2,52

Prices without VAT

Duration	P1	P2	P3
Hourly-parking	1,03	1,45	0,83
Day-parking	7,19	7,19	2,52

Simulation. Prices without VAT

Duration	P1	P2	P3
Hourly-parking	1,03	1,45	0,83
Day-parking	7,19	7,19	2,52

Revenues of day

Duration	P1	P2	P3
Hourly-parking	1 776	641	1 778
Day-parking	971	54	4 177
Total:	2 747	694	5 955

Revenues of day

Duration	P1	P2	P3
Hourly-parking	1 776	641	1 778
Day-parking	971	54	4 177
Total:	2 747	694	5 955

Average income (€) form one parking space per day

P1	P2	P3
9,16	4,63	2,34

Average income (€) form one parking space per day

P1	P2	P3
9,16	4,63	2,34

0	Additional income gathered?	0	Additional income gathered?
0	Income (€) from additional acctivities a day	0	Income (€) from additional acctivities a day

Reserve accounts

1	Debt Service Reserve Account (months)
1	Subordinated debt reserve account (months)
100%	Maintenance Reserve Account

Net operating working capital

1,00%	Accounts Receivable (% of Sales)
1,25%	Inventory (% of Sales)
1,50%	Accounts Payable (% of Routine O&M)

Financing

For public sector comparator model

#	4,1%	4,1%	Real financial discount rate (FDRr)
	6,2%	**6,2%**	Nominal financial discount rate (FDRn)

For PSC

Debt of Bank

3,0%	Interest rate on loan during construction period	
2,5%	Interest rate on loan (post construction)	
10	Term of permanent loan (years)	
3653	Term of permanent loan (days)	
70%	Percentage amount of funding financed by senior debt	<<< adjusted for the concesion period calculation if needed

For PPP

Debt of Bank

3,3%	Interest rate on loan during construction period	<<< adjuested for the concesion period calculation if needed
2,7%	Interest rate on loan (post construction)	<<< adjuested for the concesion period calculation if needed
10	Term of permanent loan (years)	
3653	Term of permanent loan (days)	
1	Type of loan amortization	<<< Enter 0 for Level Payment Amortization; Enter 1 for Level Principal Amortization
70%	Percent of project finance by debt	
15	Number of operating years for project loan coverage ratio, PLCR	
5479	Number of Operating Days for Project Loan Coverage Ratio, PLCR	

Equity Data:

1	Unlevered Beta Coefficient
2,82%	10-Year Government Borrowing Rate
3,34%	Market Risk Premium

100%	Dividend level

Subordinated debt

10	Term of permanent subordinated debt (years)
3653	Term of permanent subordinated debt (days)
60%	Percent of equity by subordinated debt
5%	Interest rate on subordinated debt

Government (in case of concetion)

0	Grant from Government (VGF)	
0	Government compensation for operaintg loss	<<< Enter 0 for no compensation; Enter 1 for compensation
100%	Percantage of compensation	
0	Annual steady government compensation for operating loss	<<< Enter 0 for no compensation; Enter 1 for compensation
150 000	Annual amount (€) of steady government compensation	

Risk assessment

70%	Confidence level

Duration of reference period (DRP) for calculation of risk estimates

25	DRP for calculation of risk estimates

0%	Part of residual value left for the private subject after PPP period

For goal seek of price and cost adjustment comparison with private entity

0%	Delay uncertainty
100%	Procurement cost uncertainty
-10%	Capex uncertainty
-10%	Opex uncertainty
0%	Demand uncertainty
0%	Price uncertainty

Profit Sharing with Government:

	0	Marginal amount of annual revenue € (MAAR) per one parking space
	0	Total marginal amount of annual revenue € (MAAR)
#	0%	**Income sharing with Government (%)**

0%	Profit Sharing with Government (%)
3	Year Profit Sharing Begins

Externalities

Costs of non-supplied public services at determined quantity and/or quality for society

3,0	Years of service are being delayed
612 000	**Annual cost (€) of unsured quality of public services**
1 676	Day cost (€) of unsured quality of public services

Appendix 20

Cash flows of the initial IP (the revenue generating model) (prepared by the author of this dissertation)

The Hypothetical IP

PUBLIC SECTOR: DAYS AND INFLATION

Period begins:	16.06.01	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:	16.12.31	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Project year	X	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Design																										
Days in period	214	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365
Days of design in period		150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inflation factors																										
Inflation Factor:	1,012	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020
Cumulative inflation factor:	1,012	1,032	1,053	1,074	1,095	1,117	1,139	1,162	1,186	1,209	1,233	1,258	1,283	1,309	1,335	1,362	1,389	1,417	1,445	1,474	1,504	1,534	1,565	1,596	1,628	1,660
Inflation Factor for expense of energy, water and waste disposal	1,018	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030
Cumulative Inflation Factor:	1,018	1,048	1,080	1,112	1,145	1,180	1,215	1,252	1,289	1,328	1,368	1,409	1,451	1,495	1,540	1,586	1,633	1,682	1,733	1,785	1,839	1,894	1,951	2,009	2,070	2,132
Construction of parking plots																										
Days of parking plots in period		215	145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Installation of parking equipment																										
Days of quipment installation in period		0	91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operation																										
Days for operation left in period		0	129	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365
Repair																										
Is medium repair needed?		FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
Is major repair needed?		FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE
Depreciation, summary																										
Parking plots		0	129	365	366	365	365	365	366	365	365	365	366	365	365	365	366	236	0	0	0	0	0	0	0	0
Equipment		0	129	365	366	365	365	365	366	365	236	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equipment (reinvestments 1)		0	0	0	0	0	0	0	0	0	128	365	366	365	365	365	366	365	237	0	0	0	0	0	0	0
Equipment (reinvestments 2)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	128	365	366	365	365	365	366	365
Debt repayment																										
Repayment days in period		0	129	365	366	365	365	365	366	365	365	365	237	0	0	0	0	0	0	0	0	0	0	0	0	0
External impact																										
Days in period the external impact is assessed		365	365	365	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The Hypothetical IP

PUBIC SECTOR: CAPEX — NOMINAL PRICES — Without VAT

Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
TEST (Used to determine time for reinvestments 1)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TEST (Used to determine time for reinvestments 2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Construction of parking plots:																									
Multi-level parking plots	10 354 004	7 122 592	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ground parking plots	591 657	407 005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parking plots, total	10 945 662	7 529 597	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional cost of parking plots construction:																									
Design	154 794	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Development fees	164 185	112 944	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advisory fees	54 728	37 648	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insurance	164 185	112 944	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Contingency	1 094 566	752 960	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional cost, total	1 632 458	1 016 496	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parking garage, total	12 578 120	8 546 093	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Instalation of parking equipment:																									
Equipment	0	138 848	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Instalation and adjustment	0	20 827	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Instalation of parking equipment, total	0	159 676	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reinvestments:																									
Renewal and reinvestments of parking equipment 1	0	0	0	0	0	0	0	0	0	187 106	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Renewal and reinvestments of parking equipment 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	219 248	0	0	0	0	0	0	0
Reinvestments, total	0	0	0	0	0	0	0	0	0	187 106	0	0	0	0	0	0	0	219 248	0	0	0	0	0	0	0
Capex: total investments	12 578 120	8 705 768	0	0	0	0	0	0	0	187 106	0	0	0	0	0	0	0	219 248	0	0	0	0	0	0	0

The Hypothetical IP

PUBIC SECTOR: CAPEX AND DEPRECIATION — NOMINAL PRICES — Without VAT

Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Compute gross fixed assets: <<< IDC is not calculated																									
Gross Fixed Assets: Parking garage	12 578 120	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212	21 124 212
Gross Fixed Assets: Equipment (investment)	0	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676
Gross Fixed Assets: Equipment (reinvestment 1)	0	0	0	0	0	0	0	0	0	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106
Gross Fixed Assets: Equipment (reinvestment 2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	219 248	219 248	219 248	219 248	219 248	219 248	219 248	219 248
Gross Fixed Assets, total	12 578 120	21 283 888	21 283 888	21 283 888	21 283 888	21 283 888	21 283 888	21 283 888	21 283 888	21 470 994	21 470 994	21 470 994	21 470 994	21 470 994	21 470 994	21 470 994	21 470 994	21 690 241	21 690 241	21 690 241	21 690 241	21 690 241	21 690 241	21 690 241	21 690 241
Calculate depreciation expense:																									
Depreciation expense: parking garage	0	124 345	351 829	352 793	351 829	351 829	351 829	352 793	351 829	351 829	351 829	352 793	351 829	351 829	351 829	352 793	227 243	0	0	0	0	0	0	0	0
Depreciation expense: equipment (investment)	0	7 049	19 946	20 000	19 946	19 946	19 946	20 000	19 946	12 896	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depreciation expense: equipment (reinvestment 1)	0	0	0	0	0	0	0	0	0	8 196	23 372	23 436	23 372	23 372	23 372	23 436	23 372	15 176	0	0	0	0	0	0	0
Depreciation expense: equipment (reinvestment 2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9 604	27 387	27 462	27 387	27 387	27 387	27 462	27 387
Depreciation expense, total	0	131 394	371 775	372 794	371 775	371 775	371 775	372 794	371 775	372 922	375 201	376 229	375 201	375 201	375 201	376 229	250 615	24 780	27 387	27 462	27 387	27 387	27 387	27 462	27 387
Calculate accumulated depreciation:																									
Depreciation expense: parking garage	0	124 345	476 174	828 967	1 180 797	1 532 626	1 884 455	2 237 248	2 589 078	2 940 907	3 292 736	3 645 529	3 997 358	4 349 188	4 701 017	5 053 810	5 281 053	5 281 053	5 281 053	5 281 053	5 281 053	5 281 053	5 281 053	5 281 053	5 281 053
Depreciation expense: equipment (investment)	0	7 049	26 995	46 996	66 941	86 887	106 833	126 833	146 779	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676	159 676
Depreciation expense: equipment (reinvestment 1)	0	0	0	0	0	0	0	0	0	8 196	31 568	55 005	78 377	101 749	125 121	148 558	171 930	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106
Depreciation expense: equipment (reinvestment 2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9 604	36 991	64 454	91 841	119 228	146 615	174 078	201 465
Depreciation expense, total	0	131 394	503 169	875 963	1 247 738	1 619 513	1 991 288	2 364 082	2 735 857	3 108 779	3 483 980	3 860 210	4 235 411	4 610 612	4 985 814	5 362 043	5 612 659	5 637 439	5 664 826	5 692 288	5 719 675	5 747 063	5 774 450	5 801 912	5 829 299
Calculate net fixed assets																									
Gross fixed assets	12 578 120	21 283 888	21 283 888	21 283 888	21 283 888	21 283 888	21 283 888	21 283 888	21 283 888	21 470 994	21 470 994	21 470 994	21 470 994	21 470 994	21 470 994	21 470 994	21 470 994	21 690 241	21 690 241	21 690 241	21 690 241	21 690 241	21 690 241	21 690 241	21 690 241
Total accumulated depreciation	0	131 394	503 169	875 963	1 247 738	1 619 513	1 991 288	2 364 082	2 735 857	3 108 779	3 483 980	3 860 210	4 235 411	4 610 612	4 985 814	5 362 043	5 612 659	5 637 439	5 664 826	5 692 288	5 719 675	5 747 063	5 774 450	5 801 912	5 829 299
Net fixed assets	12 578 120	21 152 494	20 780 719	20 407 925	20 036 150	19 664 375	19 292 600	18 919 806	18 548 031	18 362 215	17 987 014	17 610 784	17 235 583	16 860 381	16 485 180	16 108 951	15 858 335	16 052 803	16 025 416	15 997 953	15 970 566	15 943 179	15 915 792	15 888 329	15 860 942
Residual value for FNIS calculation																									
Residual value, Total	12 578 120	21 152 494	20 780 719	20 407 925	20 036 150	19 664 375	19 292 600	18 919 806	18 548 031	18 362 215	17 987 014	17 610 784	17 235 583	16 860 381	16 485 180	16 108 951	15 858 335	16 052 803	16 025 416	15 997 953	15 970 566	15 943 179	15 915 792	15 888 329	15 860 942

The Hypothetical IP

PUBIC SECTOR: revenue — NOMINAL PRICES — CONCESSION

	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Revenue																										
P1 parking plots		0	372 952	1 076 356	1 100 950	1 119 901	1 142 299	1 165 145	1 191 768	1 212 282	1 236 528	1 261 258	1 290 078	1 312 284	1 338 529	1 365 300	1 396 496	1 420 535	1 448 945	1 477 924	1 511 694	1 537 715	1 568 469	1 599 839	1 636 394	1 664 561
P2 parking plots		0	94 298	272 148	278 366	283 158	288 821	294 598	301 329	306 516	312 646	318 899	326 186	331 800	338 436	345 205	353 093	359 171	366 354	373 681	382 220	388 799	396 575	404 506	413 749	420 871
P3 parking plots		0	808 569	2 333 569	2 386 889	2 427 975	2 476 535	2 526 065	2 583 785	2 628 260	2 680 825	2 734 441	2 796 922	2 845 066	2 901 967	2 960 006	3 027 641	3 079 756	3 141 351	3 204 178	3 277 392	3 333 806	3 400 482	3 468 492	3 547 745	3 608 813
Additional activities		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Revenue, total		0	1 275 819	3 682 073	3 766 206	3 831 034	3 907 655	3 985 808	4 076 882	4 147 058	4 229 999	4 314 599	4 413 185	4 489 150	4 578 933	4 670 511	4 777 230	4 859 461	4 956 650	5 055 783	5 171 305	5 260 319	5 365 526	5 472 836	5 597 888	5 694 245

The Hypothetical IP

PUBIC SECTOR: OPEX — NOMINAL PRICES — CONCESSION — Without VAT

	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Salaries / wages		0	40 150	115 875	118 523	120 563	122 974	125 434	128 300	130 508	133 118	135 781	138 883	141 274	144 099	146 981	150 340	152 927	155 986	159 106	162 741	165 543	168 853	172 230	176 166	179 198
Electricity		0	35 094	102 277	105 642	108 514	111 770	115 123	118 911	122 143	125 808	129 582	133 846	137 484	141 609	145 857	150 657	154 752	159 395	164 177	169 579	174 189	179 415	184 797	190 878	196 067
Heating (except electricity) costs		0	188	548	566	581	599	617	637	654	674	694	717	737	759	781	807	829	854	880	908	933	961	990	1 023	1 050
Infrastructure maitenance costs:																										
Medium maitenance		0	0	0	0	0	0	0	0	0	0	0	0	471 235	0	0	0	0	0	0	0	0	0	0	0	0
Major maitenance		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 578 964	0	0	0	0	0
Maitenance, total		0	0	0	0	0	0	0	0	0	0	0	0	471 235	0	0	0	0	0	0	1 578 964	0	0	0	0	0
Other fixed costs:																										
System maitenance services		0	18 737	54 075	55 311	56 263	57 388	58 536	59 873	60 904	62 122	63 364	64 812	65 928	67 246	68 591	70 159	71 366	72 793	74 249	75 946	77 253	78 798	80 374	82 211	83 626
Accounting services		7 178	7 321	7 468	7 638	7 770	7 925	8 083	8 268	8 411	8 579	8 750	8 950	9 104	9 286	9 472	9 689	9 855	10 052	10 253	10 488	10 668	10 882	11 099	11 353	11 548
Audit services		7 219	7 363	7 510	7 682	7 814	7 971	8 130	8 316	8 459	8 628	8 801	9 002	9 157	9 340	9 527	9 744	9 912	10 110	10 312	10 548	10 730	10 944	11 163	11 418	11 615
Insurance services		15 469	15 778	16 094	16 461	16 745	17 080	17 421	17 819	18 126	18 489	18 858	19 289	19 621	20 014	20 414	20 881	21 240	21 665	22 098	22 603	22 992	23 452	23 921	24 467	24 889
Calling center seices		0	4 907	14 163	14 486	14 735	15 030	15 331	15 681	15 951	16 270	16 595	16 975	17 267	17 612	17 964	18 375	18 691	19 065	19 446	19 891	20 233	20 638	21 050	21 531	21 902
Asset management tax		0	8 922	25 750	26 338	26 792	27 328	27 874	28 511	29 002	29 582	30 173	30 863	31 394	32 022	32 662	33 409	33 984	34 664	35 357	36 165	36 787	37 523	38 273	39 148	39 822
Land rent tax per day (€)																										
PPP contract implementation monitoring tax																										
Other administration expense		30 959	31 578	32 210	32 856	33 513	34 183	34 867	35 566	36 277	37 003	37 743	38 500	39 270	40 055	40 856	41 675	42 509	43 359	44 226	45 113	46 016	46 936	47 875	48 835	49 811
Other fixed costs, total		60 824	94 607	157 269	160 772	163 631	166 904	170 242	174 034	177 129	180 672	184 285	188 391	191 741	195 575	199 487	203 931	207 557	211 709	215 943	220 753	224 679	229 172	233 756	238 963	243 213
Other viriable costs:																										
Costs of sand and oil trap services		0	803	2 318	2 370	2 411	2 459	2 509	2 566	2 610	2 662	2 716	2 778	2 825	2 882	2 940	3 007	3 059	3 120	3 182	3 255	3 311	3 377	3 445	3 523	3 584
Costs of permanent repair		0	19 406	56 006	57 286	58 272	59 437	60 626	62 012	63 079	64 341	65 627	67 127	68 282	69 648	71 041	72 664	73 915	75 393	76 901	78 658	80 012	81 612	83 245	85 147	86 612
Maitenance of equipment		0	1 338	3 863	3 951	4 019	4 099	4 181	4 277	4 350	4 437	4 526	4 629	4 709	4 803	4 899	5 011	5 098	5 200	5 304	5 425	5 518	5 628	5 741	5 872	5 973
Cleanning services		0	40 150	115 875	118 523	120 563	122 974	125 434	128 300	130 508	133 118	135 781	138 883	141 274	144 099	146 981	150 340	152 927	155 986	159 106	162 741	165 543	168 853	172 230	176 166	179 198
Wastewater treatment		0	402	1 159	1 185	1 206	1 230	1 254	1 283	1 305	1 331	1 358	1 389	1 413	1 441	1 470	1 503	1 529	1 560	1 591	1 627	1 655	1 689	1 722	1 762	1 792
Other viriable costs, total		0	62 099	179 220	183 315	186 471	190 200	194 004	198 437	201 853	205 890	210 007	214 806	218 503	222 874	227 331	232 525	236 528	241 258	246 084	251 706	256 039	261 160	266 383	272 470	277 160

The Hypothetical IP

PUBIC SECTOR: Senior Debt — NOMINAL PRICES — CONCESSION — Without VAT

	Period begins:	16.06.01	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	16.12.31	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year		X	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
TEST used for bsenior debt repayment period to determine			0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senior debt capitalization																										
Beginning Balance in the first period of loan			0	11 026 341	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amount borrowed at beginning of period			10 705 185	6 483 886	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beginning of period balance, after loan drawdown			10 705 185	17 510 227	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capitalized Interest during construction, total			321 156	339 650	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
End of Period Loan Balance			**11 026 341**	**17 849 877**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Senior debt amortization																										
Beginning balance in the first period of loan			0	17 849 877	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beginning balance in the other period of loan			0	0	17 219 450	15 435 684	13 647 031	11 863 265	10 079 499	8 295 733	6 507 080	4 723 315	2 939 549	1 155 783	0	0	0	0	0	0	0	0	0	0	0	0	0
Principal payment			0	630 427	1 783 766	1 788 653	1 783 766	1 783 766	1 788 653	1 783 766	1 783 766	1 783 766	1 783 766	1 155 783	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest expense			0	157 715	430 486	385 892	341 176	296 582	251 987	207 393	162 677	118 083	73 489	18 671	0	0	0	0	0	0	0	0	0	0	0	0	0
Total payment			0	788 142	2 214 252	2 174 545	2 124 942	2 080 348	2 035 753	1 996 046	1 946 443	1 901 849	1 857 255	1 174 454	0	0	0	0	0	0	0	0	0	0	0	0	0
Ending balance			0	17 219 450	15 435 684	13 647 031	11 863 265	10 079 499	8 295 733	6 507 080	4 723 315	2 939 549	1 155 783	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The Hypothetical IP

INITIAL PUBIC SECTOR INVESTMENT PROJECT — NOMINAL PRICES — CONCESSION — Without VAT

	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Investment, total	**19 739 529**	**12 578 120**	**8 705 768**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**187 106**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**219 248**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Immovables	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction, reconstruction, other works	19 275 418	12 423 326	8 546 093	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equipment and other long-term assets	141 576	0	159 676	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Design, technical supervisory and other services related to investments in long-term assets (A.1.-A.4.)	145 757	154 794	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Project administration and implementation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other services and costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reinvestments	176 777	0	0	0	0	0	0	0	0	0	187 106	0	0	0	0	0	0	219 248	0	0	0	0	0	0	0	0
Residual value	**3 525 462**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**15 860 942**
Revenue, total	**48 174 636**	**0**	**1 275 819**	**3 682 073**	**3 766 206**	**3 831 034**	**3 907 655**	**3 985 808**	**4 076 882**	**4 147 058**	**4 229 999**	**4 314 599**	**4 413 185**	**4 489 150**	**4 578 933**	**4 670 511**	**4 777 230**	**4 859 461**	**4 956 650**	**5 055 783**	**5 171 305**	**5 260 319**	**5 365 526**	**5 472 836**	**5 597 888**	**5 694 245**
Revenue from goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Revenue from main services	48 174 636	0	1 275 819	3 682 073	3 766 206	3 831 034	3 907 655	3 985 808	4 076 882	4 147 058	4 229 999	4 314 599	4 413 185	4 489 150	4 578 933	4 670 511	4 777 230	4 859 461	4 956 650	5 055 783	5 171 305	5 260 319	5 365 526	5 472 836	5 597 888	5 694 245
Revenue from additional services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Revenue from financial, investment and other activities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Financial and operating costs, total	**9 244 987**	**60 824**	**389 853**	**985 675**	**954 710**	**920 936**	**889 028**	**857 406**	**827 712**	**794 965**	**764 244**	**733 838**	**695 313**	**689 739**	**704 916**	**720 438**	**738 260**	**752 594**	**769 202**	**786 188**	**805 688**	**821 383**	**839 562**	**858 157**	**879 499**	**896 688**
Operating costs	**7 483 168**	**60 824**	**232 138**	**555 189**	**568 818**	**579 760**	**592 446**	**605 419**	**620 319**	**632 288**	**646 161**	**660 349**	**676 642**	**689 739**	**704 916**	**720 438**	**738 260**	**752 594**	**769 202**	**786 188**	**805 688**	**821 383**	**839 562**	**858 157**	**879 499**	**896 688**
Raw materials	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salaries/wages	1 516 058	0	40 150	115 875	118 523	120 563	122 974	125 434	128 300	130 508	133 118	135 781	138 883	141 274	144 099	146 981	150 340	152 927	155 986	159 106	162 741	165 543	168 853	172 230	176 166	179 198
Electricity costs	1 464 247	0	35 094	102 277	105 642	108 514	111 770	115 123	118 911	122 143	125 808	129 582	133 846	137 484	141 609	145 857	150 657	154 752	159 395	164 177	169 579	174 189	179 415	184 797	190 878	196 067
Heating (except electricity) costs	7 844	0	188	548	566	581	599	617	637	654	674	694	717	737	759	781	807	829	854	880	908	933	961	990	1 023	1 050
Infrastructure maintenance costs	740 234	0	1 338	3 863	3 951	4 019	4 099	4 181	4 277	4 350	4 437	4 526	4 629	475 944	4 803	4 899	5 011	5 098	5 200	5 304	1 584 389	5 518	5 628	5 741	5 872	5 973
Other costs	3 754 784	60 824	155 367	332 626	340 137	346 083	353 005	360 065	368 195	374 631	382 124	389 767	398 567	-65 700	413 646	421 919	431 445	438 988	447 767	456 723	-1 111 929	475 200	484 704	494 398	505 561	514 399
Interest on loans (G.3.1.)	1 761 819	0	157 715	430 486	385 892	341 176	296 582	251 987	207 393	162 677	118 083	73 489	18 671	0	0	0	0	0	0	0	0	0	0	0	0	0
Taxes (-negative impact)- positive impact on project cash flows	**-4 718 280**	**2 654 178**	**1 600 607**	**-680 979**	**-696 341**	**-708 086**	**-722 018**	**-736 223**	**-752 821**	**-765 508**	**-741 269**	**-795 906**	**-813 839**	**-827 544**	**-843 804**	**-860 381**	**-879 755**	**-894 557**	**-866 079**	**-930 027**	**-950 955**	**-966 941**	**-985 912**	**-1 005 251**	**-1 027 856**	**-1 045 119**
Total import/purchase VAT	5 398 394	2 654 178	1 868 529	92 256	94 562	96 431	98 589	100 797	103 324	105 374	147 031	110 159	112 929	115 178	117 771	120 426	123 463	125 930	174 817	131 687	135 019	137 726	140 849	144 044	147 700	150 673
Total sales VAT	10 116 674	0	267 922	773 235	790 903	804 517	820 608	837 020	856 145	870 882	888 300	906 066	926 769	942 721	961 576	980 807	1 003 218	1 020 487	1 040 897	1 061 714	1 085 974	1 104 667	1 126 760	1 149 296	1 175 556	1 195 791
Total sum of other indirect taxes	0																									
Net revenue	**19 190 121**	**-12 638 944**	**-7 819 802**	**2 696 398**	**2 811 496**	**2 910 098**	**3 018 627**	**3 128 402**	**3 249 170**	**3 352 093**	**3 278 649**	**3 580 761**	**3 717 872**	**3 799 411**	**3 874 017**	**3 950 073**	**4 038 970**	**4 106 867**	**3 968 201**	**4 269 595**	**4 365 617**	**4 438 937**	**4 525 964**	**4 614 680**	**4 718 389**	**4 797 557**
Financing, total	**11 520 136**	**15 293 122**	**9 420 409**	**-1 783 766**	**-1 788 653**	**-1 783 766**	**-1 783 766**	**-1 783 766**	**-1 788 653**	**-1 783 766**	**-1 783 766**	**-1 783 766**	**-1 155 783**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Requested financing	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
EU structural assistance funds	0																									
LT co-financing funds	0																									
Other international financing funds	0																									
Funds of special budgetary programme for VAT financing	0																									
Own funds	**6 879 161**	**4 266 781**	**3 227 299**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Public funds (state, municipal budget, other public funds)	6 879 161	4 266 781	3 227 299	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Private funds (own, other private resources)	0																									
Loans	**4 640 975**	**11 026 341**	**6 193 109**	**-1 783 766**	**-1 788 653**	**-1 783 766**	**-1 783 766**	**-1 783 766**	**-1 788 653**	**-1 783 766**	**-1 783 766**	**-1 783 766**	**-1 155 783**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Loans	16 432 690	11 026 341	6 823 536	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loans reimbursement (not including interest)	11 791 715	0	630 427	1 783 766	1 788 653	1 783 766	1 783 766	1 783 766	1 788 653	1 783 766	1 783 766	1 783 766	1 155 783	0	0	0	0	0	0	0	0	0	0	0	0	0

Financial cash flows:

Cash flow for investment FA indicators	24 477 402	-12 638 944	-7 662 087	3 126 884	3 197 388	3 251 274	3 315 209	3 380 389	3 456 563	3 514 770	3 396 732	3 654 249	3 736 543	3 799 411	3 874 017	3 950 073	4 038 970	4 106 867	3 968 201	4 269 595	4 365 617	4 438 937	4 525 964	4 614 680	4 718 389	20 658 499
Cumulative financial sustainability cash flow		0	0	1 593 611	1 719 184	1 834 418	1 956 880	2 080 859	2 213 338	2 333 835	2 236 151	2 592 901	3 375 928	4 626 955	4 717 821	4 810 455	4 918 725	5 001 424	4 834 280	5 199 622	5 316 572	5 405 877	5 511 876	5 619 931	5 746 245	5 842 675
Cash flow for capital FA indicators		-4 327 605	-2 739 622	912 632	1 022 843	1 126 333	1 234 861	1 344 636	1 460 517	1 568 327	1 681 989	1 796 995	2 562 089	3 799 411	3 874 017	3 950 073	4 038 970	4 106 867	4 187 448	4 269 595	4 365 617	4 438 937	4 525 964	4 614 680	4 718 389	20 658 499
Cash flow for investment FA indicators without residual value		-12 638 944	-7 662 087	3 126 884	3 197 388	3 251 274	3 315 209	3 380 389	3 456 563	3 514 770	3 396 732	3 654 249	3 736 543	3 799 411	3 874 017	3 950 073	4 038 970	4 106 867	3 968 201	4 269 595	4 365 617	4 438 937	4 525 964	4 614 680	4 718 389	4 797 557
Cash flow for investment FA indicators by strecing period	20 953 940	-11 901 077	-18 694 647	-16 084 060	-13 570 453	-11 163 703	-8 852 895	-6 634 213	-4 497 981	-2 452 591	-591 292	1 294 216	3 109 631	4 847 822	6 516 675	8 118 952	9 661 641	11 138 686	12 482 541	13 844 051	15 154 908	16 409 967	17 614 924	18 771 776	19 885 571	20 951 940

Financial indicators: NPV of indicators depending on the length of a period

	NPV=0	NPV=1	NPV=2	NPV=3	NPV=4	NPV=5	NPV=6	NPV=7	NPV=8	NPV=9	NPV=10	NPV=11	NPV=12	NPV=13	NPV=14	NPV=15	NPV=16	NPV=17	NPV=18	NPV=19	NPV=20	NPV=21	NPV=22	NPV=23	NPV=24	NPV=25
Financial net present value - FNPV(i)	24 477 402	-57 273	60 157	1 265 442	2 473 108	3 668 023	4 853 809	6 028 278	7 194 873	8 341 279	9 470 606	10 575 101	11 665 901	12 732 923	13 779 811	14 805 869	15 814 472	16 842 178	17 918 918	18 954 317	19 958 588	20 925 463	21 859 513	22 761 698	23 636 077	24 477 402
Financial internal rate of return - FIRR(i)	15,5%	#NUM!	6,7%	10,5%	11,6%	12,2%	12,6%	12,9%	13,2%	13,5%	13,7%	13,9%	14,1%	14,3%	14,4%	14,6%	14,7%	14,8%	15,0%	15,1%	15,2%	15,3%	15,3%	15,4%	15,5%	15,5%
Financial modified internal rate of return - FMIRR(i)	10,0%	#DIV/0!	6,7%	9,7%	10,7%	11,1%	11,2%	11,3%	11,3%	11,2%	11,1%	11,1%	11,0%	10,9%	10,8%	10,7%	10,6%	10,6%	10,5%	10,4%	10,3%	10,3%	10,2%	10,1%	10,0%	10,0%
Financial cost-benefit ratio	2,03	0,00	1,06	1,43	1,53	1,58	1,62	1,65	1,67	1,70	1,72	1,74	1,76	1,78	1,80	1,33	1,84	1,86	1,89	1,91	1,94	1,96	1,98	2,00	2,02	2,03
Financial sustainability (real values)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

	0	NPV=1	NPV=2	NPV=3	NPV=4	NPV=5	NPV=6	NPV=7	NPV=8	NPV=9	NPV=10	NPV=11	NPV=12	NPV=13	NPV=14	NPV=15	NPV=16	NPV=17	NPV=18	NPV=19	NPV=20	NPV=21	NPV=22	NPV=23	NPV=24	NPV=25
NPV(i)	20 951 940	-11 901 077	-18 694 647	-16 084 060	-13 570 453	-11 163 703	-8 852 895	-6 634 213	-4 497 981	-2 452 591	-591 292	1 294 216	3 109 631	4 847 822	6 516 675	8 118 952	9 661 641	11 138 686	12 482 541	13 844 051	15 154 908	16 409 967	17 614 924	18 771 776	19 885 571	20 951 940
IRR(i)					-42%	-24%	-13%	-6%	-1%	3%	6%	8%	9%	10%	11%	12%	13%	13%	14%	14%	14%	14%	14%	15%	15%	15%

Appendix 21

Risk assessment of the initial IP (the revenue generating model) (prepared by the author of this dissertation)

The Hypothetical IP

PUBIC SECTOR: RISK ESTIMATES — NOMINAL PRICES — CONCESSION — Without VAT

Duration of reference period (DRP) for calculation of risk estimates	Period begins:		17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
25	Period ends:		17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year		NPV	Sum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Investment, total		**6 771 805**	**7 428 761**	**4 334 036**	**2 977 061**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**54 178**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**63 485**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Land		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Immovables		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction, reconstruction, other works		6 650 422	7 234 887	4 286 307	2 948 580	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equipment and other long-term assets		25 253	28 481	0	28 481	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Design, technical supervisory and other services related to investments in long-term assets (A.1.-A.4.)		44 943	47 730	47 730	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Project administration and implementation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other services and costs		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reinvestments		51 187	117 663	0	0	0	0	0	0	0	0	0	54 178	0	0	0	0	0	0	0	63 485	0	0	0	0	0	0	0
Residual value insert viriable for simulation of length period		462 189	2 079 372	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2 079 372
Revenue, total		**12 631 402**	**28 207 544**	**0**	**334 520**	**965 440**	**987 500**	**1 004 498**	**1 024 588**	**1 045 080**	**1 068 959**	**1 087 360**	**1 109 107**	**1 131 289**	**1 157 138**	**1 177 056**	**1 200 597**	**1 224 609**	**1 252 591**	**1 274 152**	**1 299 635**	**1 325 628**	**1 355 918**	**1 379 257**	**1 406 842**	**1 434 979**	**1 467 768**	**1 493 032**
Revenue from goods		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Revenue from services		12 631 402	28 207 544	0	334 520	965 440	987 500	1 004 498	1 024 588	1 045 080	1 068 959	1 087 360	1 109 107	1 131 289	1 157 138	1 177 056	1 200 597	1 224 609	1 252 591	1 274 152	1 299 635	1 325 628	1 355 918	1 379 257	1 406 842	1 434 979	1 467 768	1 493 032
Revenue from financial, investment and other activities		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Financial and operating costs, total		**3 444 482**	**7 954 353**	**22 839**	**104 943**	**256 990**	**257 082**	**256 151**	**255 889**	**255 734**	**256 303**	**255 758**	**255 942**	**256 244**	**256 184**	**337 706**	**264 696**	**270 525**	**277 217**	**282 599**	**288 835**	**295 214**	**1 634 621**	**308 429**	**315 256**	**322 238**	**330 252**	**336 707**
Operating costs		**3 245 922**	**7 678 893**	**22 839**	**87 168**	**208 473**	**213 591**	**217 700**	**222 464**	**227 335**	**232 930**	**237 424**	**242 634**	**247 961**	**254 079**	**337 706**	**264 696**	**270 525**	**277 217**	**282 599**	**288 835**	**295 214**	**1 634 621**	**308 429**	**315 256**	**322 238**	**330 252**	**336 707**
Raw materials		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salaries/wages		569 280	1 271 276	0	15 076	43 511	44 505	45 271	46 177	47 100	48 177	49 006	49 986	50 986	52 151	53 048	54 109	55 191	56 453	57 424	58 573	59 744	61 109	62 161	63 404	64 673	66 150	67 289
Electricity costs		549 825	1 260 767	0	13 178	38 405	39 669	40 747	41 970	43 229	44 651	45 865	47 241	48 658	50 259	51 625	53 174	54 769	56 572	58 110	59 853	61 648	63 677	65 408	67 370	69 391	71 675	73 623
Heating (except electricity) costs		2 946	6 754	0	71	206	213	218	225	232	239	246	253	261	269	277	285	293	303	311	321	330	341	350	361	372	384	394
Infrastructure maintenance costs		277 958	812 226	0	503	1 450	1 484	1 509	1 539	1 570	1 606	1 634	1 666	1 700	1 738	178 717	1 804	1 840	1 882	1 914	1 952	1 991	594 938	2 072	2 113	2 156	2 205	2 243
Other costs		1 845 914	4 327 870	22 839	58 340	124 901	127 721	129 954	132 553	135 204	138 257	140 674	143 488	146 357	149 662	54 038	155 324	158 430	162 008	164 840	168 137	171 499	914 555	178 438	182 006	185 647	189 838	193 157
Interest on loans (G.3.1.)		198 560	275 460	0	17 775	48 517	43 491	38 451	33 425	28 399	23 374	18 334	13 308	8 282	2 104	0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenue		**2 415 115**	**12 824 431**	**-4 356 876**	**-2 747 484**	**708 450**	**730 418**	**748 347**	**768 699**	**789 346**	**812 656**	**831 601**	**798 987**	**875 045**	**900 955**	**839 351**	**935 901**	**954 085**	**975 374**	**991 553**	**947 314**	**1 030 414**	**-278 703**	**1 070 828**	**1 091 587**	**1 112 741**	**1 137 515**	**1 156 326**

Risk group																												
Design risks	44 943	47 730	47 730	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired construction quality risks	6 650 422	7 234 887	4 286 307	2 948 580	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired services quality risks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired equipment quality risks	25 253	28 481	0	28 481	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Financial accessibility risks	198 560	275 460	0	17 775	48 517	43 491	38 451	33 425	28 399	23 374	18 334	13 308	8 282	2 104	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Availability risks	3 245 922	7 678 893	22 839	87 168	208 473	213 591	217 700	222 464	227 335	232 930	237 424	242 634	247 961	254 079	337 706	264 696	270 525	277 217	282 599	288 835	296 214	1 634 621	308 429	315 256	322 238	330 252	336 707
Demand risks	12 631 402	28 207 544	0	334 520	965 440	987 500	1 004 498	1 024 588	1 045 080	1 068 959	1 087 360	1 109 107	1 131 289	1 157 138	1 177 056	1 200 597	1 224 609	1 252 591	1 274 152	1 299 635	1 325 628	1 355 918	1 379 257	1 406 842	1 434 979	1 467 768	1 493 032
Residual value risks	513 376	2 197 035	0	0	0	0	0	0	0	0	0	54 178	0	0	0	0	0	0	0	63 485	0	0	0	0	0	0	0	2 079 372
Total value of risk in period	23 309 877	45 670 029	4 356 876	3 416 524	1 222 430	1 244 582	1 260 649	1 280 477	1 300 814	1 325 263	1 343 118	1 419 227	1 387 533	1 413 322	1 514 762	1 465 293	1 495 134	1 529 808	1 556 751	1 651 955	1 620 842	2 990 539	1 687 686	1 722 098	1 757 217	1 798 020	3 909 111
Residual value for risk assessment, year			12 578 120	21 152 494	20 780 719	20 407 925	20 036 150	19 664 375	19 292 600	18 919 806	18 548 031	18 362 215	17 987 014	17 610 784	17 235 583	16 860 381	16 485 180	16 108 951	15 858 335	16 052 803	16 025 416	15 997 953	15 970 566	15 943 179	15 915 792	15 888 329	15 860 942

NPV of Risk values depending on the length of a period																												
Design risks	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943
Acquired construction quality risks	4 036 070	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422	6 650 422
Acquired services quality risks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired equipment quality risks	0	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253	25 253
Financial accessibility risks	0	15 760	56 266	90 456	118 919	142 217	160 857	175 302	185 972	193 264	197 538	198 560	198 560	198 560	198 560	198 560	198 560	198 560	198 560	198 560	198 560	198 560	198 560	198 560	198 560	198 560	198 560	198 560
Availability risks	21 506	98 793	272 844	440 758	601 910	756 974	906 183	1 050 139	1 188 306	1 321 261	1 449 204	1 572 649	1 727 146	1 841 172	1 950 905	2 056 789	2 158 426	2 256 242	2 350 381	2 841 206	2 928 411	3 012 342	3 093 124	3 171 081	3 245 922			
Demand risks	0	296 601	1 102 633	1 878 950	2 622 528	3 336 699	4 022 626	4 683 266	5 316 046	5 923 800	6 507 519	7 069 720	7 608 211	8 125 406	8 622 146	9 100 575	9 558 827	9 998 956	10 421 679	10 828 818	11 218 787	11 593 334	11 953 068	12 299 541	12 631 402			
Residual value risks	1 552 724	62	2 274 522	2 103 313	1 944 441	1 796 951	1 660 054	1 532 935	1 415 078	1 348 804	1 246 413	1 151 416	1 063 426	981 886	906 344	836 325	777 416	763 897	721 144	680 951	643 170	607 653	574 267	542 879	513 376			
NPV of risk depending on the length of a period			5 655 244	7 131 834	10 426 882	11 234 093	12 008 415	12 753 459	13 470 338	14 162 260	14 826 018	15 507 747	16 121 291	16 712 962	17 317 959	17 867 641	18 398 572	18 912 865	19 413 846	19 938 272	20 412 381	21 270 152	21 709 545	22 132 507	22 539 636	22 932 679	23 309 877		

Appendix 22

Risk allocation (the revenue generating model) (prepared by the author of this dissertation)

	Period begins:	16.06.01	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	16.12.31	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

Risk factorsand their allocation	Private	Public
Design risks	**75,0%**	**25%**
RF1: Occasional restriction on the land transferred to implementation of the IP that have not been known in advance	0%	100%
RF2: Errors in project design	100%	0%
RF3: Delay of design work	100%	0%
RF4: Cost-overrrun of design work	100%	0%
Acquired construction quality risks	**75,0%**	**25%**
RF1: Occasional restrictions on the work of the contract due to the requirements of archaeological and cultural heritage protection that have not been known in advance	0%	100%
RF2: Quality of contruction is not ensured due to a lack of resources	100%	0%
RF3: Delay of construction work	100%	0%
RF4: Cost-overrrun of construction work	100%	0%
Acquired services quality risks	**75,0%**	**25%**
RF1: The duration of the services is deviating from the plan	100%	0%
RF2: The price of the services is deviating from the predetermined value	100%	0%
RF3: Changes of requirements from the public sector for quality of services	0%	100%
RF4: Cost-overrrun of construction work	100%	0%
Acquired equipment quality risks	**100,0%**	**0%**
RF1: Delay to acquire the equipment	100%	0%
FR1:Delay to install equipment due to a lack of human resources	100%	0%
RF3: Changes of requirements from the public sector for quality of services	100%	0%
RF4: Damage done to the third parties by installing the equipment	100%	0%
Financial accessibility risks	**100,0%**	**0%**
RF1: Increase of financing needed due to cost overrun	100%	0%
RF2: interest rate changes	100%	0%
RF3: Increase of financing needed due to chages in taxation sytem (excluding VAT)	100%	0%
RF4: Non-compliance of the terms and conditions of the main loan	100%	0%
Availability risks	**100,0%**	**0%**
RF1: Use of low-quality materials and equipment	100%	0%
RF2: Damange made to the third parties	100%	0%
RF3: Necessary permissions (licenses) are not obtained	100%	0%
e availability of services or infrastructure is not ensured due to a lack of human res	100%	0%
Demand risks	**88,0%**	**12%**
RF1: Aging of technologies	100%	0%
RF2: Delay to start providing the services	100%	0%
RF3: Changes of competition in the market	50%	50%
RF4: Changes in pricing	100%	0%
Residual value risks	**100,0%**	**0%**
RF1: Deviation from the property maintenance plan	100%	0%
RF2: Inaccurate plan of maintenance costs	100%	0%
RF3: Lack of information on the use of property during the operation period	100%	0%
RF4: Restrictions on the management, use and disposal rights of transferred / returned assets due to transactions with third parties	100%	0%

NPV of risk groups	Private	Public		
Design risks	33 707	11 236		
Acquired construction quality risks	4 987 816	1 662 605		
Acquired services quality risks	0	0		
Acquired equipment quality risks	25 253	0		
Financial accessibility risks	198 560	0		
Availability risks	3 245 922	0		
Demand risks	11 115 634	1 515 768		
Residual value risks	513 376	0	Private	Public
Total	**20 120 268**	**3 189 609**	86%	14%

Appendix 23

Calculation of FOPSmax, FOPSrtn, MPpr and risk values (the revenue generating model) (prepared by the author of this dissertation)

The Hypothetical IP

PUBIC SECTOR: MAXIMUM OBLIGATION — NOMINAL PRICES — CONCESSION — Without VAT

Payments calculation																												
Period begins:		17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:		17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Period number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Risk values (adjusted)	**NPV**																									
Design risks	44 943	47 730	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired construction quality risks	6 650 422	4 286 307	2 948 580	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired services quality risks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired equipment quality risks	25 253	0	28 481	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Financial accessibility risks	198 560	0	17 775	48 517	43 491	38 451	33 425	28 399	23 374	18 334	13 308	8 282	2 104	0	0	0	0	0	0	0	0	0	0	0	0	0
Availability risks	3 245 922	22 839	87 168	208 473	213 591	217 700	222 464	227 335	232 930	237 424	242 634	247 961	254 079	337 706	264 696	270 525	277 217	282 599	288 835	295 214	1 634 621	308 429	315 256	322 238	330 252	336 707
Demand risks	12 631 402	0	334 520	965 440	987 500	1 004 498	1 024 588	1 045 080	1 068 959	1 087 360	1 109 107	1 131 289	1 157 138	1 177 056	1 200 597	1 224 609	1 252 591	1 274 152	1 299 635	1 325 628	1 355 918	1 379 257	1 406 842	1 434 979	1 467 768	1 493 032
Residual value risks	513 376	0	0	0	0	0	0	0	0	0	54 178	0	0	0	0	0	0	0	63 485	0	0	0	0	0	0	2 079 372
Total value of risk in period	**23 309 877**	**4 356 876**	**3 416 524**	**1 222 430**	**1 244 582**	**1 260 649**	**1 280 477**	**1 300 814**	**1 325 263**	**1 343 118**	**1 419 227**	**1 387 533**	**1 413 322**	**1 514 762**	**1 465 293**	**1 495 134**	**1 529 808**	**1 556 751**	**1 651 955**	**1 620 842**	**2 990 539**	**1 687 686**	**1 722 098**	**1 757 217**	**1 798 020**	**3 909 111**

Maximum obligations of the public sector	**NPV**																									
Based on actual actual cost	5 226 200	17 048 414	11 198 656	-1 661 862	-1 708 963	-1 745 819	-1 788 787	-1 832 469	-1 882 841	-1 922 150	-1 726 770	-2 014 725	-2 069 764	-2 030 063	-2 152 803	-2 197 659	-2 250 296	-2 290 027	-2 054 712	-2 385 747	-1 110 355	-2 485 204	-2 536 257	-2 588 259	-2 649 306	-615 952

NPV of values depending on the length of a period	NPVt=1	NPVt=2	NPVt=3	NPVt=4	NPVt=5	NPVt=6	NPVt=7	NPVt=8	NPVt=9	NPVt=10	NPVt=11	NPVt=12	NPVt=13	NPVt=14	NPVt=15	NPVt=16	NPVt=17	NPVt=18	NPVt=19	NPVt=20	NPVt=21	NPVt=22	NPVt=23	NPVt=24	NPVt=25
NPV of total risks	4 102 520	7 131 772	8 152 360	9 130 780	10 063 974	10 956 508	11 810 283	12 629 325	13 410 941	14 188 631	14 904 566	15 591 234	16 284 222	16 915 443	17 521 917	18 106 228	18 666 118	19 225 563	19 742 425	20 640 389	21 117 563	21 576 041	22 016 557	22 440 987	23 309 877
Max. obligation based on actual costs	16 053 120	25 982 380	24 594 917	23 251 426	21 959 086	20 712 244	19 509 522	18 345 885	17 227 306	16 281 090	15 241 540	14 235 937	13 307 204	12 379 817	11 488 376	10 628 873	9 805 259	9 109 418	8 348 639	8 015 235	7 312 571	6 637 338	5 988 489	5 361 109	5 226 200

The Hypothetical IP

PUBIC SECTOR: RETAINED OBLIGATION AND PAYMENT — NOMINAL PRICES — CONCESSION — Without VAT

	Period begins:	16.06.01	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	16.12.31	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Risk retained by the Public sector in period	**NPV**																										
Design risks	11 236		11 932	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired construction quality risks	1 662 605		1 071 577	737 145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired services quality risks	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired equipment quality risks	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Financial accessibility risks	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Availability risks	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Demand risks	1 515 768		0	40 142	115 853	118 500	120 540	122 951	125 410	128 275	130 483	133 093	135 755	138 857	141 247	144 072	146 953	150 311	152 898	155 956	159 075	162 710	165 511	168 821	172 197	176 132	179 164
Residual value risks	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**3 189 609**		**1 083 509**	**777 287**	**115 853**	**118 500**	**120 540**	**122 951**	**125 410**	**128 275**	**130 483**	**133 093**	**135 755**	**138 857**	**141 247**	**144 072**	**146 953**	**150 311**	**152 898**	**155 956**	**159 075**	**162 710**	**165 511**	**168 821**	**172 197**	**176 132**	**179 164**
Transferred risk			**3 273 367**	**2 639 236**	**1 106 578**	**1 126 082**	**1 140 110**	**1 157 527**	**1 175 405**	**1 196 988**	**1 212 635**	**1 286 134**	**1 251 778**	**1 274 465**	**1 373 515**	**1 321 222**	**1 348 181**	**1 379 497**	**1 403 853**	**1 495 999**	**1 461 766**	**2 827 828**	**1 522 176**	**1 553 277**	**1 585 020**	**1 621 888**	**3 729 947**

Maximum payment to the private sector in the PPP	**NPV**																									
Based on actual actual cost	-831 672		15 912 311	10 301 323	-2 020 307	-2 071 306	-2 111 165	-2 157 682	-2 204 985	-2 259 575	-2 302 135	-2 110 598	-2 402 471	-2 462 077	-2 425 896	-2 552 795	-2 601 893	-2 659 474	-2 703 014	-2 472 202	-2 807 829	-1 537 786	-2 916 761	-2 972 688	-3 029 660	-3 096 501	-1 067 610

NPV of values depending on the length of a period	NPVt=1	NPVt=2	NPVt=3	NPVt=4	NPVt=5	NPVt=6	NPVt=7	NPVt=8	NPVt=9	NPVt=10	NPVt=11	NPVt=12	NPVt=13	NPVt=14	NPVt=15	NPVt=16	NPVt=17	NPVt=18	NPVt=19	NPVt=20	NPVt=21	NPVt=22	NPVt=23	NPVt=24	NPVt=25
Retained obligation of the public sector in the PPP			1 020 253	1 709 419	1 806 157	1 889 313	1 968 545	2 074 249	2 156 556	2 235 833	2 311 767	2 384 695	2 454 744	2 522 208	2 586 826	2 648 899	2 708 499	2 765 910	2 820 900	2 873 716	2 924 443	2 973 299	3 020 096	3 065 041	3 108 209	3 149 784	3 189 609
Maximum payment to the private sector in the PPP based on actual costs			14 983 343	24 116 985	22 430 262	20 801 918	19 239 132	17 735 158	16 287 940	14 891 473	13 551 765	12 395 226	11 155 606	9 959 396	8 849 573	7 749 877	6 694 466	5 678 677	4 706 531	3 869 306	2 973 931	2 512 182	1 687 503	896 075	136 571	-594 371	-831 672

Appendix 24

Calculation of neutrality costs (the revenue generating model) (prepared by the author of this dissertation)

The Hypothetical IP																													
PUBIC SECTOR: NEUTRALITY			NOMINAL PRICES																										
	Period begins:	16.06.01	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	16.12.31	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	X	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Other fixed costs:																											
Land rent tax	93 670		6 188	6 311	6 438	6 585	6 698	6 832	6 969	7 128	7 250	7 395	7 543	7 716	7 849	8 006	8 166	8 352	8 496	8 666	8 839	9 041	9 197	9 381	9 568	9 787	9 955
Real estate tax	2 072 068		0	66 399	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873
PPP contract implementation monitoring tax	702 524		46 406	47 335	48 281	49 384	50 235	51 239	52 264	53 458	54 378	55 466	56 575	57 868	58 864	60 041	61 242	62 642	63 720	64 994	66 294	67 809	68 976	70 356	71 763	73 402	74 666
Contribution for the municipality	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other obligations, total	2 868 262		52 594	120 045	242 592	243 842	244 806	245 944	247 106	248 459	249 502	250 735	251 992	253 457	254 586	255 920	257 281	258 867	260 089	261 533	263 006	264 723	266 046	267 609	269 204	271 063	272 495
Profit tax	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neutrality costs, total	2 868 262		52 594	120 045	242 592	243 842	244 806	245 944	247 106	248 459	249 502	250 735	251 992	253 457	254 586	255 920	257 281	258 867	260 089	261 533	263 006	264 723	266 046	267 609	269 204	271 063	272 495

Calculation of non-financial benefits (the revenue generating model) (prepared by the author of this dissertation)

The Hypothetical IP																													
PUBIC SECTOR: EXTERNALITIES			NOMINAL PRICES		CONCESSION																								
	Period begins:	16.06.01	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	16.12.31	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	X	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Costs of Externalities :																											
Social cost of services not being delivered	1 714 350		631 128	643 750	656 625	1 376	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 25

Calculation of Public Sector Comparator (the revenue generating model) (prepared by the author of this dissertation)

The Hypothetical IP

VALUE FOR MONEY NOMINAL PRICES CONCESSION

	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
PSC (Pu. S.) = PSC (PPA)		NPV$_{n=1}$	NPV$_{n=2}$	NPV$_{n=3}$	NPV$_{n=4}$	NPV$_{n=5}$	NPV$_{n=6}$	NPV$_{n=7}$	NPV$_{n=8}$	NPV$_{n=9}$	NPV$_{n=10}$	NPV$_{n=11}$	NPV$_{n=12}$	NPV$_{n=13}$	NPV$_{n=14}$	NPV$_{n=15}$	NPV$_{n=16}$	NPV$_{n=17}$	NPV$_{n=18}$	NPV$_{n=19}$	NPV$_{n=20}$	NPV$_{n=21}$	NPV$_{n=22}$	NPV$_{n=23}$	NPV$_{n=24}$	NPV$_{n=25}$	
Procurement and oversight cost	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**
Net base cost	**-20 262 241**	**11 901 077**	**18 694 647**	**16 084 060**	**13 570 453**	**11 163 703**	**8 852 895**	**6 634 213**	**4 497 981**	**2 452 591**	**591 292**	**-1 294 216**	**-3 109 631**	**-4 632 237**	**-6 301 090**	**-7 903 367**	**-9 446 056**	**-10 923 101**	**-12 266 956**	**-13 628 466**	**-14 465 210**	**-15 720 269**	**-16 925 226**	**-18 082 078**	**-19 195 873**	**-20 262 241**
Raw cost	27 912 395	11 901 077	19 825 849	20 289 367	20 736 540	21 165 706	21 578 661	21 976 021	22 359 391	22 727 346	23 183 949	23 524 674	23 853 424	24 384 557	24 688 222	24 980 454	25 262 433	25 533 106	25 867 850	26 118 554	26 834 590	27 066 826	27 290 345	27 505 475	27 713 085	27 912 395
Capex	19 739 529	11 843 804	19 562 751	19 562 751	19 562 751	19 562 751	19 562 751	19 562 751	19 562 751	19 562 751	19 665 279	19 665 279	19 665 279	19 665 279	19 665 279	19 665 279	19 665 279	19 665 279	19 739 529	19 739 529	19 739 529	19 739 529	19 739 529	19 739 529	19 739 529	19 739 529
Opex	8 172 866	57 273	263 097	726 616	1 173 789	1 602 955	2 015 909	2 413 270	2 796 640	3 164 594	3 518 670	3 859 395	4 188 144	4 719 278	5 022 943	5 315 175	5 597 154	5 867 827	6 128 321	6 379 025	7 095 061	7 327 298	7 550 816	7 765 947	7 973 556	8 172 866
Total revenue	**48 174 636**	**0**	**1 131 202**	**4 205 308**	**7 166 087**	**10 002 003**	**12 725 765**	**15 341 808**	**17 861 410**	**20 274 755**	**22 592 657**	**24 818 890**	**26 963 054**	**29 016 794**	**30 989 312**	**32 883 821**	**34 708 489**	**36 456 207**	**38 134 806**	**39 747 020**	**41 299 799**	**42 787 095**	**44 215 571**	**45 587 553**	**46 908 958**	**48 174 636**
Main services	48 174 636	0	1 131 202	4 205 308	7 166 087	10 002 003	12 725 765	15 341 808	17 861 410	20 274 755	22 592 657	24 818 890	26 963 054	29 016 794	30 989 312	32 883 821	34 708 489	36 456 207	38 134 806	39 747 020	41 299 799	42 787 095	44 215 571	45 587 553	46 908 958	48 174 636
Additional services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk	**23 132 868**	**4 102 520**	**7 131 772**	**8 152 360**	**9 130 780**	**10 063 974**	**10 956 508**	**11 810 283**	**12 629 325**	**13 410 941**	**14 188 631**	**14 904 566**	**15 591 234**	**16 329 166**	**16 960 387**	**17 566 861**	**18 151 172**	**18 711 062**	**19 270 506**	**19 787 369**	**20 463 379**	**20 940 554**	**21 399 032**	**21 839 547**	**22 263 977**	**23 132 868**
Retained risk	3 189 609	1 020 253	1 709 433	1 806 157	1 899 315	1 988 545	2 074 245	2 156 556	2 235 833	2 311 767	2 384 697	2 454 744	2 522 208	2 586 826	2 648 890	2 708 499	2 765 910	2 820 900	2 873 716	2 924 443	2 973 299	3 020 096	3 065 041	3 108 209	3 149 786	3 189 609
Transferable risk	19 943 258	3 082 266	5 422 338	6 346 203	7 231 465	8 075 429	8 882 263	9 653 727	10 393 492	11 099 174	11 803 934	12 449 822	13 069 026	13 742 339	14 311 497	14 858 362	15 385 262	15 890 162	16 396 791	16 862 926	17 490 080	17 920 458	18 333 990	18 731 338	19 114 191	19 943 258
Competitive neutrality	**2 774 592**	**49 524**	**155 961**	**358 497**	**550 192**	**731 409**	**902 840**	**1 065 025**	**1 218 579**	**1 363 774**	**1 501 169**	**1 631 191**	**1 754 334**	**1 870 804**	**1 981 050**	**2 085 411**	**2 184 285**	**2 277 827**	**2 366 397**	**2 450 266**	**2 529 754**	**2 604 975**	**2 676 222**	**2 743 708**	**2 807 694**	**2 868 262**
Profit tax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other taxes and obligations	2 774 592	49 524	155 961	358 497	550 192	731 409	902 840	1 065 025	1 218 579	1 363 774	1 501 169	1 631 191	1 754 334	1 870 804	1 981 050	2 085 411	2 184 285	2 277 827	2 366 397	2 450 266	2 529 754	2 604 975	2 676 222	2 743 708	2 807 694	2 868 262
PSC (Pu. S.)	**5 695 219**	**16 103 120**	**26 032 380**	**24 644 917**	**23 301 426**	**22 009 086**	**20 762 244**	**19 559 522**	**18 395 885**	**17 277 306**	**16 331 092**	**15 291 540**	**14 285 937**	**13 617 733**	**12 690 346**	**11 798 905**	**10 939 402**	**10 115 788**	**9 419 948**	**8 659 168**	**8 577 924**	**7 875 260**	**7 200 027**	**6 551 178**	**5 925 798**	**5 788 888**
NFBs, Total	**1 714 350**	594 282	1 165 061	1 713 268	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350
PSC (Pu. S. including NFBs)	**7 409 568**	**16 697 402**	**27 197 441**	**26 358 184**	**25 015 776**	**23 723 436**	**22 476 593**	**21 273 872**	**20 110 235**	**18 991 655**	**18 045 441**	**17 005 890**	**16 000 287**	**15 332 083**	**14 404 695**	**13 513 255**	**12 653 752**	**11 830 138**	**11 134 297**	**10 373 518**	**10 292 273**	**9 589 610**	**8 914 377**	**8 265 527**	**7 640 148**	**7 503 238**

Cash flows of the Shadow bid model (the revenue generating model) (prepared by the author of this dissertation)

The Hypothetical IP

CONCESSION MODEL: DAYS AND INFLATION

Period begins:	16.06.01	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:	16.12.31	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Project year	X	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Design																										
Days in period	214	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365
Sum of days in the refference period		365	730	1 095	1 461	1 826	2 191	2 556	2 922	3 287	3 652	4 017	4 383	4 748	5 113	5 478	5 844	6 209	6 574	6 939	7 305	7 670	8 035	8 400	8 766	9 131
Days left of garage construction in period		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Days of garage construction in period		150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inflation factors																										
Does Period Have Either 365 or 366 Days?	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Inflation Factor:	1,012	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020
Cumulative inflation factor:	1,012	1,032	1,053	1,074	1,095	1,117	1,139	1,162	1,186	1,209	1,233	1,258	1,283	1,309	1,335	1,362	1,389	1,417	1,445	1,474	1,504	1,534	1,565	1,596	1,628	1,660
Inflation Factor for expense of energy, water and waste disposal	1,018	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030
Cumulative Inflation Factor:	1,018	1,048	1,080	1,112	1,145	1,180	1,215	1,252	1,289	1,328	1,368	1,409	1,451	1,495	1,540	1,586	1,633	1,682	1,733	1,785	1,839	1,894	1,951	2,009	2,070	2,132
Construction of parking plots																										
Days of parking plots in period		215	145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Installation of parking equipment																										
Days of quipment installation in period		0	91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operation																										
Cumulative days for operation left in period		0	129	494	860	1 225	1 590	1 955	2 321	2 686	3 051	3 416	3 782	4 147	4 512	4 877	5 243	5 608	5 973	6 338	6 704	7 069	7 434	7 799	8 165	8 530
Repair																										
Is medium repair needed?		FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
Is major repair needed?		FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE
Depreciation of parking plots																										
Depreciation days in period		0	129	365	366	365	365	365	366	365	365	365	366	365	365	365	366	236	0	0	0	0	0	0	0	0
Depreciation of equipment																										
Depreciation days in period		0	129	365	366	365	365	236	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depreciation of reinvestments No. 1																										
Depreciation days in period		0	0	0	0	0	0	0	0	0	128	365	366	365	365	237	0	0	0	0	0	0	0	0	0	0
Depreciation of reinvestments No. 2																										
Depreciation days in period		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	128	365	366	365	365	237	0	0
Depreciation, summary																										
Parking plots		0	129	365	366	365	365	365	366	365	365	365	366	365	365	365	366	236	0	0	0	0	0	0	0	0
Equipment		0	129	365	366	365	365	236	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equipment (reinvestments 1)		0	0	0	0	0	0	0	0	0	128	365	366	365	365	237	0	0	0	0	0	0	0	0	0	0
Equipment (reinvestments 2)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	128	365	366	365	365	237	0	0
Time for debt capitalization																										
Investments days in period		365	236	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cumulative investments days in period		365	601	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Time for debt repayment																										
Repayment days in period		0	129	365	366	365	365	365	366	365	365	365	236,5	0	0	0	0	0	0	0	0	0	0	0	0	0
Time for subordinated debt repayment																										
Repayment days in period		0	129	365	366	365	365	365	366	365	365	365	237	0	0	0	0	0	0	0	0	0	0	0	0	0

The Hypothetical IP

CONCESSION MODEL: CAPEX

		NOMINAL PRICES		CONCESSION																							
	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.31	31.01.31	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Construction of parking plots:																										
Multi-level parking plots	14 458 285	9 318 604	6 410 333	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ground parking plots	826 188	532 492	366 305	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parking plots, total	**15 284 472**	**9 851 095**	**6 776 637**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Additional cost of parking plots construction:																										
Design	131 181	139 315	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Development fees	206 340	132 990	91 485	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advisory fees	68 780	44 330	30 495	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insurance	206 340	132 990	91 485	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Contingency	1 375 603	886 599	609 897	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional cost, total	**1 988 245**	**1 336 223**	**823 361**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Parking garage, total	**17 272 717**	**11 187 318**	**7 599 999**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Instalation of parking equipment:																										
Equipment	110 799	0	124 964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Instalation and adjustment	14 958	0	16 870	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Instalation of parking equipment, total	**125 756**	**0**	**141 834**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Reinvestments:																										
Renewal and reinvestments of parking equipment 1	91 071	0	0	0	0	0	0	0	0	0	166 199	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Renewal and reinvestments of parking equipment 2	65 953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	194 749	0	0	0	0	0	0	0
Reinvestments, total	**157 024**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**166 199**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**194 749**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Capex: total (re)-investments (Excl. Interest During Construction, IDC)	**17 555 498**	**11 187 318**	**7 741 832**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**166 199**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**194 749**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Compute External Funding Required, Net of Government Grant:																										
Capex: total investments, excluding IDC	17 398 474	11 187 318	7 741 832	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grant from government	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
External funding required, net of government grant	**17 398 474**	**11 187 318**	**7 741 832**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Compute Capitalized Loan Interest During Construction (IDC):																										
Beginning of period balance, before loan drawdown	7 172 579	0	8 089 550	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amount borrowed at beginning of period	12 178 932	7 831 123	5 419 283	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beginning of period balance, after loan drawdown	19 351 510	7 831 123	13 508 832	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capitalized interest during construction, total	498 905	**258 427**	**288 238**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Capitalized interest during construction for parking garage	494 223	258 427	282 957	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capitalized interest during construction for equipment	4 682	0	5 281	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
End of Period Loan Balance	**19 850 415**	**8 089 550**	**13 797 070**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Compute Capitalized Subordinated Debt Interest During Construction (IDC):																										
Beginning of period balance, before subordinated debt drawdown	1 844 377	0	2 080 170	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amount left for financing of **private subject** at beginning of period	5 219 542	3 356 195	2 322 550	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amount sub. Debt borrowed at beginning of period	3 131 725	2 013 717	1 393 530	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capitalized interest during construction for parking garage, total	88 936	**66 453**	**29 734**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Capitalized interest during construction for parking garage	88 453	66 453	29 189	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capitalized interest during construction for equipment	483	0	545	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
End of Period Subordinated Debt Balance	**3 220 662**	**2 080 170**	**1 423 264**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Compute Total Capex for funding:																										
Capex: Investments and capitalized IDC	17 986 315	11 512 198	8 059 804	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capex:Reinvestments	157 024	0	0	0	0	0	0	0	0	0	166 199	0	0	0	0	0	0	0	194 749	0	0	0	0	0	0	0
Total Capex	**18 143 340**	**11 512 198**	**8 059 804**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**166 199**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**194 749**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

The Hypothetical IP

CONCESSION MODEL: CAPEX AND DEPRECIATION — NOMINAL PRICES — CONCESSION

Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Compute gross fixed assets:																									
Gross Fixed Assets: Parking garage	11 187 318	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317
Gross Fixed Assets: Equipment (investment)	0	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834
Gross Fixed Assets: Equipment (reinvestment 1)	0	0	0	0	0	0	0	0	0	166 199	166 199	166 199	166 199	166 199	166 199	166 199	166 199	166 199	166 199	166 199	166 199	166 199	166 199	166 199	166 199
Gross Fixed Assets: Equipment (reinvestment 2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	194 749	194 749	194 749	194 749	194 749	194 749	194 749	194 749
Gross Fixed Assets, total	11 187 318	18 929 151	18 929 151	18 929 151	18 929 151	18 929 151	18 929 151	18 929 151	18 929 151	19 095 349	19 095 349	19 095 349	19 095 349	19 095 349	19 095 349	19 095 349	19 095 349	19 290 098	19 290 098	19 290 098	19 290 098	19 290 098	19 290 098	19 290 098	19 290 098
Calculate depreciation expense:																									
Depreciation expense: parking garage	0	442 357	1 251 631	1 255 060	1 251 631	1 251 631	1 251 631	1 255 060	1 251 631	1 251 631	1 251 631	1 255 060	1 251 631	1 251 631	1 255 060	808 416	0	0	0	0	0	0	0	0	0
Depreciation expense: equipment (investment)	0	10 019	28 347	28 425	28 347	28 347	18 348	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depreciation expense: equipment (reinvestment 1)	0	0	0	0	0	0	0	0	0	11 649	33 217	33 308	33 217	33 217	21 591	0	0	0	0	0	0	0	0	0	0
Depreciation expense: equipment (reinvestment 2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13 650	38 923	39 030	38 923	38 923	25 300	0	0
Depreciation expense, total	0	452 376	1 279 978	1 283 485	1 279 978	1 279 978	1 269 979	1 255 060	1 251 631	1 263 279	1 284 847	1 288 368	1 284 847	1 284 847	1 273 222	1 255 060	808 416	13 650	38 923	39 030	38 923	38 923	25 300	0	0
Calculate accumulated depreciation:																									
Depreciation expense: parking garage	0	442 357	1 693 988	2 949 047	4 200 678	5 452 308	6 703 939	7 958 998	9 210 629	10 462 259	11 713 890	12 968 950	14 220 580	15 472 211	16 723 841	17 978 901	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317	18 787 317
Depreciation expense: equipment (investment)	0	10 019	38 366	66 791	95 138	123 486	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834	141 834
Depreciation expense: equipment (reinvestment 1)	0	0	0	0	0	0	0	0	0	11 649	44 866	78 174	111 391	144 608	166 199	166 199	166 199	166 199	166 199	166 199	166 199	166 199	166 199	166 199	166 199
Depreciation expense: equipment (reinvestment 2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13 650	52 573	91 603	130 526	169 449	194 749	194 749	194 749
Depreciation expense, total	0	452 376	1 732 354	3 015 838	4 295 816	5 575 794	6 845 772	8 100 832	9 352 463	10 615 742	11 900 589	13 188 957	14 473 804	15 758 652	17 031 873	18 286 933	19 095 349	19 108 999	19 147 922	19 186 952	19 225 875	19 264 798	19 290 098	19 290 098	19 290 098
Calculate net fixed assets																									
Gross fixed assets	11 187 318	18 929 151	18 929 151	18 929 151	18 929 151	18 929 151	18 929 151	18 929 151	18 929 151	19 095 349	19 095 349	19 095 349	19 095 349	19 095 349	19 095 349	19 095 349	19 095 349	19 290 098	19 290 098	19 290 098	19 290 098	19 290 098	19 290 098	19 290 098	19 290 098
Total accumulated depreciation	0	452 376	1 732 354	3 015 838	4 295 816	5 575 794	6 845 772	8 100 832	9 352 463	10 615 742	11 900 589	13 188 957	14 473 804	15 758 652	17 031 873	18 286 933	19 095 349	19 108 999	19 147 922	19 186 952	19 225 875	19 264 798	19 290 098	19 290 098	19 290 098
Net fixed assets	11 187 318	18 476 775	17 196 797	15 913 312	14 633 335	13 353 357	12 083 378	10 828 318	9 576 688	8 479 607	7 194 760	5 906 392	4 621 545	3 336 697	2 063 476	808 416	0	181 099	142 176	103 146	64 223	25 300	0	0	0

Residual value for FNIS calculation

Residual value, Total	11 187 318	18 476 775	17 196 797	15 913 312	14 633 335	13 353 357	12 083 378	10 828 318	9 576 688	8 479 607	7 194 760	5 906 392	4 621 545	3 336 697	2 063 476	808 416	0	181 099	142 176	103 146	64 223	25 300	0	0	0

The Hypothetical IP

CONCESSION MODEL: FUNDING — NOMINAL PRICES — CONCESSION

Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
TEST used for bank loan repayment period to determine		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TEST used for subordinated loan repayment period to determine		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calculate total funding tequired:																										
Capex per period	18 143 340	11 512 198	8 059 804	0	0	0	0	0	0	0	166 199	0	0	0	0	0	0	194 749	0	0	0	0	0	0	0	0
Total capex (cumulative)	239 317 205	11 512 198	19 572 002	19 572 002	19 572 002	19 572 002	19 572 002	19 572 002	19 572 002	19 572 002	19 738 200	19 738 200	19 738 200	19 738 200	19 738 200	19 738 200	19 738 200	19 932 949	19 932 949	19 932 949	19 932 949	19 932 949	19 932 949	19 932 949	19 932 949	19 932 949
Grant from government	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cumulative government grant amount	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net financing needed, excluding DSRA (Cumulative)	28 193 576	11 512 198	19 572 002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Initial funding of debt service reserve account	129 520	0	146 078	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Initial funding of subordinated debt service reserve account	39 634	0	44 701	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total financing needed (Cumulative)	28 323 096	11 512 198	19 718 080	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total financing needed (per period)	18 115 835	11 512 198	8 205 882	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calculate cumulative funding amounts of debt and equity:																										
Debt financing (per period)	12 681 085	8 058 539	5 744 117	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cumulative amount of debt financing	19 826 167	**8 058 539**	**13 802 656**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial financing of the private subject during construction (per period)	5 434 751	3 453 659	2 461 765	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net private financing needed, excluding DSRA (Cumulative)	8 496 929	**3 453 659**	**5 915 424**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial subordinated debt financing during construction (per period)	3 260 850	2 072 196	1 477 059	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cumulative amount of sub. Debt	5 098 157	**2 072 196**	**3 549 254**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial pure equity financing during construction (per period)	2 173 900	1 381 464	984 706	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional equity financing during operating period (per period)	159 715	169 617	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total equity financing (Cumulative)	**30 881 642**	**1 551 081**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**	**2 535 787**
Loan Amortization: Level Payment																										
Beginning Balance in the first period of loan		0	13 802 656	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beginning Balance in latter periods		0	0	13 371 215	12 138 821	10 873 153	9 573 311	8 238 374	6 867 394	5 459 397	4 013 385	2 528 330	1 003 178	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Payment	10 525 895	0	563 153	1 593 416	1 593 416	1 593 416	1 593 416	1 593 416	1 593 416	1 593 416	1 593 416	1 593 416	1 029 626	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest Expense	1 522 828	0	131 711	361 023	327 748	293 575	258 479	222 436	185 420	147 404	108 361	68 265	17 539	0	0	0	0	0	0	0	0	0	0	0	0	0
Principal Payment (adjusted for the modeling)	8 998 738	0	431 441	1 232 394	1 265 668	1 299 841	1 334 937	1 370 980	1 407 997	1 446 013	1 485 055	1 525 152	1 003 178	0	0	0	0	0	0	0	0	0	0	0	0	0
Ending Balance		0	13 371 215	12 138 821	10 873 153	9 573 311	8 238 374	6 867 394	5 459 397	4 013 385	2 528 330	1 003 178	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan Amortization: Level Payment																										
Beginning Balance in the first period of loan		0	13 802 656	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beginning Balance in latter periods		0	0	13 371 215	12 138 821	10 873 153	9 573 311	8 238 374	6 867 394	5 459 397	4 013 385	2 528 330	1 003 178	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Payment	10 525 895	0	563 153	1 593 416	1 593 416	1 593 416	1 593 416	1 593 416	1 593 416	1 593 416	1 593 416	1 593 416	1 029 626	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest Expense	1 522 828	0	131 711	361 023	327 748	293 575	258 479	222 436	185 420	147 404	108 361	68 265	17 539	0	0	0	0	0	0	0	0	0	0	0	0	0
Principal Payment (adjusted for the modeling)	8 998 738	0	431 441	1 232 394	1 265 668	1 299 841	1 334 937	1 370 980	1 407 997	1 446 013	1 485 055	1 525 152	1 003 178	0	0	0	0	0	0	0	0	0	0	0	0	0
Ending Balance		0	13 371 215	12 138 821	10 873 153	9 573 311	8 238 374	6 867 394	5 459 397	4 013 385	2 528 330	1 003 178	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Selected Loan Amortization Used In Model Calculations																										
Beginning Balance		0	13 802 656	13 315 170	11 935 849	10 552 749	9 173 428	7 794 108	6 414 787	5 031 687	3 652 366	2 273 045	893 724	0	0	0	0	0	0	0	0	0	0	0	0	0
Principal Payment	9 118 101	0	487 486	1 379 321	1 383 100	1 379 321	1 379 321	1 379 321	1 383 100	1 379 321	1 379 321	1 379 321	893 724	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest Expense	1 471 338	0	131 711	359 510	322 268	284 924	247 683	210 441	173 199	135 856	98 614	61 372	15 593	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Payment	10 589 439	0	619 197	1 738 830	1 705 368	1 664 245	1 627 003	1 589 762	1 556 299	1 515 176	1 477 935	1 440 693	909 317	0	0	0	0	0	0	0	0	0	0	0	0	0
Ending Balance		0	13 315 170	11 935 849	10 552 749	9 173 428	7 794 108	6 414 787	5 031 687	3 652 366	2 273 045	893 724	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subordinated Debt amortization																										
Beginning balance in the first period of loan		0	3 549 254	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beginning balance in the other period of loan		0	0	3 423 918	3 069 284	2 713 678	2 359 045	2 004 411	1 649 777	1 294 171	939 537	584 903	230 269	0	0	0	0	0	0	0	0	0	0	0	0	0
Principal payment	2 344 570	0	125 336	354 634	355 606	354 634	354 634	354 634	355 606	354 634	354 634	354 634	230 269	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest expense	663 476	0	22 167	171 196	153 464	135 684	117 952	100 221	82 489	64 709	46 977	29 245	4 828	0	0	0	0	0	0	0	0	0	0	0	0	0
Total payment	3 008 046	0	147 503	525 830	509 070	490 318	472 586	454 854	438 094	419 343	401 611	383 879	235 097	0	0	0	0	0	0	0	0	0	0	0	0	0
Ending balance		0	3 423 918	3 069 284	2 713 678	2 359 045	2 004 411	1 649 777	1 294 171	939 537	584 903	230 269	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The Hypothetical IP

CONCESSION MODEL: OPEX NOMINAL PRICES CONCESSION

	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Salaries / wages	1 364 452	0	36 135	104 288	106 670	108 507	110 677	112 890	115 470	117 457	119 806	122 203	124 995	127 146	129 689	132 283
Electricity	1 317 823	0	31 585	92 049	95 078	97 663	100 593	103 610	107 020	109 929	113 227	116 624	120 461	123 736	127 448	131 272
Heating (except electricity) costs	7 060	0	169	493	509	523	539	555	573	589	607	625	645	663	683	703
Infrastructure maitenance costs:																
Medium maitenance 1	194 027	0	0	0	0	0	0	0	0	0	0	0	0	424 112	0	0
Medium maitenance 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major maitenance	426 702	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maitenance, total	**620 728**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**424 112**	**0**	**0**
Other fixed costs:																
System maitenance services	636 744	0	16 863	48 668	49 780	50 636	51 649	52 682	53 886	54 813	55 910	57 028	58 331	59 335	60 522	61 732
Accounting services	97 791	6 460	6 589	6 721	6 874	6 993	7 132	7 275	7 441	7 569	7 721	7 875	8 055	8 194	8 358	8 525
Audit services	98 353	6 497	6 627	6 759	6 914	7 033	7 173	7 317	7 484	7 613	7 765	7 921	8 102	8 241	8 406	8 574
Insurance services	210 757	13 922	14 200	14 484	14 815	15 070	15 372	15 679	16 037	16 314	16 640	16 973	17 360	17 659	18 012	18 373
Calling center serices	166 766	0	4 417	12 746	13 037	13 262	13 527	13 798	14 113	14 356	14 643	14 936	15 277	15 540	15 851	16 168
Asset management tax	303 212	0	8 030	23 175	23 705	24 113	24 595	25 087	25 660	26 102	26 624	27 156	27 777	28 255	28 820	29 396
Land rent tax	93 670	6 188	6 311	6 438	6 585	6 698	6 832	6 969	7 128	7 250	7 395	7 543	7 716	7 849	8 006	8 166
Real estate tax	2 072 068	0	66 399	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873	187 873
PPP contract implementation monitoring tax	702 524	46 406	47 335	48 281	49 384	50 235	51 239	52 264	53 458	54 378	55 466	56 575	57 868	58 864	60 041	61 242
Contribution for the municipality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other administration expense	421 538	27 863	28 420	28 989	29 570	30 161	30 765	31 380	32 009	32 649	33 302	33 968	34 650	35 343	36 049	36 770
Other fixed costs, total	**4 803 425**	**107 336**	**205 191**	**384 134**	**388 537**	**392 074**	**396 158**	**400 323**	**405 090**	**408 918**	**413 339**	**417 848**	**423 008**	**427 152**	**431 938**	**436 819**
Other viriable costs:																
Costs of sand and oil trap services	27 289	0	723	2 086	2 133	2 170	2 214	2 258	2 309	2 349	2 396	2 444	2 500	2 543	2 594	2 646
Costs of permanent repair	659 485	0	17 465	50 406	51 557	52 445	53 494	54 564	55 810	56 771	57 906	59 065	60 414	61 454	62 683	63 937
Maitenance of equipment	45 482	0	1 205	3 476	3 556	3 617	3 689	3 763	3 849	3 915	3 994	4 073	4 166	4 238	4 323	4 409
Cleanning services	1 364 452	0	36 135	104 288	106 670	108 507	110 677	112 890	115 470	117 457	119 806	122 203	124 995	127 146	129 689	132 283
Wastewater treatment	15 463	0	371	1 080	1 116	1 146	1 180	1 216	1 256	1 290	1 329	1 368	1 413	1 452	1 495	1 540
Other viriable costs, total	**2 112 171**	**0**	**55 898**	**161 335**	**165 033**	**167 884**	**171 254**	**174 690**	**178 694**	**181 783**	**185 431**	**189 153**	**193 489**	**196 834**	**200 785**	**204 815**
Operation expenditure, total	**10 225 660**	**107 336**	**328 978**	**742 299**	**755 828**	**766 651**	**779 219**	**792 070**	**806 847**	**818 676**	**832 410**	**846 453**	**862 599**	**1 299 643**	**890 543**	**905 892**

The Hypothetical IP

CONCESSION MODEL: REVENUE — NOMINAL PRICES — CONCESSION

Period begins:		17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:		17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Revenue																										
P1 parking plots	14 082 577	0	372 952	1 076 356	1 100 950	1 119 901	1 142 299	1 165 145	1 191 768	1 212 282	1 236 528	1 261 258	1 290 078	1 312 284	1 338 529	1 365 300	1 396 496	1 420 535	1 448 945	1 477 924	1 511 694	1 537 715	1 568 469	1 599 839	1 636 394	1 664 561
P2 parking plots	3 560 665	0	94 298	272 148	278 366	283 158	288 821	294 598	301 329	306 516	312 646	318 899	326 186	331 800	338 436	345 205	353 093	359 171	366 354	373 681	382 220	388 799	396 575	404 506	413 749	420 871
P3 parking plots	30 531 394	0	808 569	2 333 569	2 386 889	2 427 975	2 476 535	2 526 065	2 583 785	2 628 260	2 680 825	2 734 441	2 796 922	2 845 066	2 901 967	2 960 006	3 027 641	3 079 756	3 141 351	3 204 178	3 277 392	3 333 806	3 400 482	3 468 492	3 547 745	3 608 813
Main activities	**48 174 636**	**0**	**1 275 819**	**3 682 073**	**3 766 206**	**3 831 034**	**3 907 655**	**3 985 808**	**4 076 882**	**4 147 058**	**4 229 999**	**4 314 599**	**4 413 185**	**4 489 150**	**4 578 933**	**4 670 511**	**4 777 230**	**4 859 461**	**4 956 650**	**5 055 783**	**5 171 305**	**5 260 319**	**5 365 526**	**5 472 836**	**5 597 888**	**5 694 245**
Additional activities	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Revenue, total	48 174 636	**0**	**1 275 819**	**3 682 073**	**3 766 206**	**3 831 034**	**3 907 655**	**3 985 808**	**4 076 882**	**4 147 058**	**4 229 999**	**4 314 599**	**4 413 185**	**4 489 150**	**4 578 933**	**4 670 511**	**4 777 230**	**4 859 461**	**4 956 650**	**5 055 783**	**5 171 305**	**5 260 319**	**5 365 526**	**5 472 836**	**5 597 888**	**5 694 245**
Income sharing																										
Marginal amount of annual revenue € (MAAR)		0	271 384	783 226	798 933	814 912	831 210	847 834	864 837	882 134	899 777	917 772	936 178	954 902	974 000	993 480	1 013 404	1 033 672	1 054 345	1 075 432	1 097 000	1 118 940	1 141 319	1 164 145	1 187 492	1 211 241
Income above MMAI		0	1 004 435	2 898 847	2 967 273	3 016 123	3 076 445	3 137 974	3 212 044	3 264 923	3 330 222	3 396 826	3 477 007	3 534 248	3 604 933	3 677 032	3 763 826	3 825 789	3 902 305	3 980 351	4 074 305	4 141 380	4 224 207	4 308 691	4 410 396	4 483 003
Income sharing with governement		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Income left for the private subject		**0**	**1 275 819**	**3 682 073**	**3 766 206**	**3 831 034**	**3 907 655**	**3 985 808**	**4 076 882**	**4 147 058**	**4 229 999**	**4 314 599**	**4 413 185**	**4 489 150**	**4 578 933**	**4 670 511**	**4 777 230**	**4 859 461**	**4 956 650**	**5 055 783**	**5 171 305**	**5 260 319**	**5 365 526**	**5 472 836**	**5 597 888**	**5 694 245**
Revenue for calculation of VfM for the users		0	1 275 819	3 682 073	3 766 206	3 831 034	3 907 655	3 985 808	4 076 882	4 147 058	4 229 999	4 314 599	4 413 185	4 489 150	4 578 933	4 670 511	4 777 230	4 859 461	4 956 650	5 055 783	5 171 305	5 260 319	5 365 526	5 472 836	5 597 888	5 694 245
NPV depending on a length of a period		0	1 131 202	4 205 308	7 166 087	10 002 003	12 725 765	15 341 808	17 861 410	20 274 755	22 592 657	24 818 890	26 963 054	29 016 794	30 989 312	32 883 821	34 708 489	36 456 207	38 134 806	39 747 020	41 299 799	42 787 095	44 215 571	45 587 553	46 908 958	48 174 636

The Hypothetical IP

CONCESSION MODEL: RESERVE ACCOUNT — NOMINAL PRICES — CONCESSION

Period begins:		16.06.01	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:		16.12.31	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	X	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Debt Service Reserve Account:																											
Debt Payment			0	619 197	1 738 830	1 705 368	1 664 245	1 627 003	1 589 762	1 556 299	1 515 176	1 477 935	1 440 693	909 317	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Required for Debt Service Reserve Account		0	51 600	144 903	142 114	138 687	135 584	132 480	129 692	126 265	123 161	120 058	75 776	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Flow to Debt Service Reserve Account		0	51 600	93 303	-2 789	-3 427	-3 103	-3 103	-2 789	-3 427	-3 103	-3 103	-44 281	-75 776	0	0	0	0	0	0	0	0	0	0	0	0
Subordinated debt reserve account:																											
Subordinated debt payment			0	147 503	525 830	509 070	490 318	472 586	454 854	438 094	419 343	401 611	383 879	235 097	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Required for subordinated debt Service Reserve Account		0	12 292	43 819	42 422	40 860	39 382	37 905	36 508	34 945	33 468	31 990	19 591	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Flow to subordinated debt Service Reserve Account			12 292	31 527	-1 397	-1 563	-1 478	-1 478	-1 397	-1 563	-1 478	-1 478	-12 399	-19 591	0	0	0	0	0	0	0	0	0	0	0	0	0
Infrastructure maitenance reserve account:																											
Opex: Medium maitenance 1			0	0	0	0	0	0	0	0	0	0	0	0	424 112	0	0	0	0	0	0	0	0	0	0	0	0
Opex: Medium maitenance 2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Opex: Major maitenance			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 421 068	0	0	0	0	0
Total: Maitenance expense			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**424 112**	**0**	**0**	**0**	**0**	**0**	**0**	**1 421 068**	**0**	**0**	**0**	**0**	**0**
Cash Flow to: Medium maitenance 1			0	14 466	40 931	41 043	40 931	40 931	40 931	41 043	40 931	40 931	40 931	41 043	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Flow to: Medium maitenance 2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Flow to: Major maitenance			0	28 924	81 838	82 062	81 838	81 838	81 838	82 062	81 838	81 838	81 838	82 062	81 838	81 838	81 838	82 062	81 838	81 838	81 838	0	0	0	0	0	0
Total cash flow for maitenance			**0**	**43 390**	**122 769**	**123 105**	**122 769**	**122 769**	**122 769**	**123 105**	**122 769**	**122 769**	**122 769**	**123 105**	**81 838**	**81 838**	**81 838**	**82 062**	**81 838**	**81 838**	**81 838**	**0**	**0**	**0**	**0**	**0**	**0**
Cash Flow Released from MRA			0	0	0	0	0	0	0	0	0	0	0	0	-424 112	0	0	0	0	0	0	-1 421 068	0	0	0	0	0
Cash Flow to or from MRA Reserve Account			**0**	**43 390**	**122 769**	**123 105**	**122 769**	**122 769**	**122 769**	**123 105**	**122 769**	**122 769**	**122 769**	**123 105**	**-342 274**	**81 838**	**81 838**	**82 062**	**81 838**	**81 838**	**81 838**	**-1 421 068**	**0**	**0**	**0**	**0**	**0**
Cash Balance in MRA Reserve Account			**0**	**43 390**	**166 159**	**289 264**	**412 033**	**534 802**	**657 571**	**780 676**	**903 445**	**1 026 214**	**1 148 983**	**1 272 089**	**929 815**	**1 011 653**	**1 093 491**	**1 175 554**	**1 257 392**	**1 339 230**	**1 421 068**	**0**	**0**	**0**	**0**	**0**	**0**

The Hypothetical IP

CONCESSION MODEL: NET OPERATING WORKING CAPITAL — NOMINAL PRICES — CONCESSION

Period begins:		17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:		17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Calculate Net Operating Working Capital Components:																										
Accounts Receivable (% of revenue)	0	12 758	36 821	37 662	38 310	39 077	39 858	40 769	41 471	42 300	43 146	44 132	44 891	45 789	46 705	47 772	48 595	49 567	50 558	51 713	52 603	53 655	54 728	55 979	56 942	
Inventory (% of revenue)	0	15 948	46 026	47 078	47 888	48 846	49 823	50 961	51 838	52 875	53 932	55 165	56 114	57 237	58 381	59 715	60 743	61 958	63 197	64 641	65 754	67 069	68 410	69 974	71 178	
Accounts Payable (% of routine O&M, excluding contribution for the municipality)	1 610	4 935	11 134	11 337	11 500	11 688	11 881	12 103	12 280	12 486	12 697	12 939	19 495	13 358	13 588	13 853	14 065	14 311	14 563	36 169	15 085	15 354	15 629	15 946	16 200	

Financial statements of the Shadow bid model (the revenue generating model) (prepared by the author of this dissertation)

The Hypothetical IP																										
CONCESSION MODEL: PROFIT & LOSS STATEMENT (P&L)		NOMINAL PRICES		CONCESSION																						
	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Revenues		0	1 275 819	3 682 073	3 766 206	3 831 034	3 907 655	3 985 808	4 076 882	4 147 058	4 229 999	4 314 599	4 413 185	4 489 150	4 578 933	4 670 511	4 777 230	4 859 461	4 956 650	5 055 783	5 171 305	5 260 319	5 365 526	5 472 836	5 597 888	5 694 245
Total Operating Expense		-107 336	328 978	742 299	755 828	766 651	779 219	792 070	806 847	818 676	832 410	846 453	862 599	1 299 643	890 543	905 892	923 539	937 681	954 094	970 878	2 411 237	1 005 640	1 023 590	1 041 947	1 063 042	1 079 971
EBITDA		-107 336	946 841	2 939 774	3 010 379	3 064 384	3 128 436	3 193 739	3 270 035	3 328 381	3 397 588	3 468 146	3 550 586	3 189 507	3 688 390	3 764 619	3 853 691	3 921 780	4 002 556	4 084 906	2 760 069	4 254 679	4 341 936	4 430 890	4 534 846	4 614 273
Depreciation		0	452 376	1 279 978	1 283 485	1 279 978	1 279 978	1 269 979	1 255 060	1 251 631	1 263 279	1 284 847	1 288 368	1 284 847	1 284 847	1 273 222	1 255 060	808 416	13 650	38 923	39 030	38 923	38 923	25 300	0	0
EBIT		-107 336	494 465	1 659 796	1 726 894	1 784 406	1 848 458	1 923 760	2 014 975	2 076 751	2 134 309	2 183 299	2 262 219	1 904 659	2 403 542	2 491 397	2 598 632	3 113 363	3 988 906	4 045 982	2 721 039	4 215 756	4 303 013	4 405 590	4 534 846	4 614 273
Interest Income		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest Expense		0	153 878	530 705	475 732	420 608	365 635	310 661	255 688	200 564	145 591	90 617	20 420	0	0	0	0	0	0	0	0	0	0	0	0	0
Earnings Before Profit Sharing and Tax		-107 336	340 587	1 129 091	1 251 162	1 363 798	1 482 823	1 613 099	1 759 287	1 876 187	1 988 719	2 092 681	2 241 799	1 904 659	2 403 542	2 491 397	2 598 632	3 113 363	3 988 906	4 045 982	2 721 039	4 215 756	4 303 013	4 405 590	4 534 846	4 614 273
Compensation for operating loss		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Earnings Before Profit Sharing and Tax (after compensation)		-107 336	340 587	1 129 091	1 251 162	1 363 798	1 482 823	1 613 099	1 759 287	1 876 187	1 988 719	2 092 681	2 241 799	1 904 659	2 403 542	2 491 397	2 598 632	3 113 363	3 988 906	4 045 982	2 721 039	4 215 756	4 303 013	4 405 590	4 534 846	4 614 273
Profit Sharing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EBT		-107 336	340 587	1 129 091	1 251 162	1 363 798	1 482 823	1 613 099	1 759 287	1 876 187	1 988 719	2 092 681	2 241 799	1 904 659	2 403 542	2 491 397	2 598 632	3 113 363	3 988 906	4 045 982	2 721 039	4 215 756	4 303 013	4 405 590	4 534 846	4 614 273
EBT of previous period		0	-107 336	233 251	1 129 091	1 251 162	1 363 798	1 482 823	1 613 099	1 759 287	1 876 187	1 988 719	2 092 681	2 241 799	1 904 659	2 403 542	2 491 397	2 598 632	3 113 363	3 988 906	4 045 982	2 721 039	4 215 756	4 303 013	4 405 590	4 534 846
Government grant depreciation recovery		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EBT for tax payment		-107 336	233 251	1 129 091	1 251 162	1 363 798	1 482 823	1 613 099	1 759 287	1 876 187	1 988 719	2 092 681	2 241 799	1 904 659	2 403 542	2 491 397	2 598 632	3 113 363	3 988 906	4 045 982	2 721 039	4 215 756	4 303 013	4 405 590	4 534 846	4 614 273
Taxes	3 704 789	0	34 988	169 364	187 674	204 570	222 423	241 965	263 893	281 428	298 308	313 902	336 270	285 699	360 531	373 710	389 795	467 005	598 336	606 897	408 156	632 363	645 452	660 838	680 227	692 141
Net Earnings		**-107 336**	**305 599**	**959 727**	**1 063 488**	**1 159 228**	**1 260 400**	**1 371 134**	**1 495 394**	**1 594 759**	**1 690 411**	**1 778 779**	**1 905 529**	**1 618 961**	**2 043 011**	**2 117 688**	**2 208 837**	**2 646 359**	**3 390 570**	**3 439 085**	**2 312 883**	**3 583 393**	**3 657 561**	**3 744 751**	**3 854 619**	**3 922 132**

The Hypothetical IP																										
CONCESSION MODEL: BALANCE SHEET		NOMINAL PRICES		CONCESSION																						
	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
ASSETS																										
Cash (Debt Service Reserve Account)		51 600	144 903	142 114	138 687	135 584	132 480	129 692	126 265	123 161	120 058	75 776	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash (Subordinated Debt Service Reserve Account)		12 292	43 819	42 422	40 860	39 382	37 905	36 508	34 945	33 468	31 990	19 591	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash (MRA Reserve Account)		0	43 390	166 159	289 264	412 033	534 802	657 571	780 676	903 445	1 026 214	1 148 983	1 272 089	929 815	1 011 653	1 093 491	1 175 554	1 257 392	1 339 230	1 421 068	0	0	0	0	0	0
Cash and Cash Equivalents		63 892	232 111	350 695	468 811	586 999	705 187	823 770	941 886	1 060 074	1 178 262	1 244 351	1 272 089	929 815	1 011 653	1 093 491	1 175 554	1 257 392	1 339 230	1 421 068	0	0	0	0	0	0
Accounts Receivable		0	12 758	36 821	37 662	38 310	39 077	39 858	40 769	41 471	42 300	43 146	44 132	44 891	45 789	46 705	47 772	48 595	49 567	50 558	51 713	52 603	53 655	54 728	55 979	56 942
Inventory		0	15 948	46 026	47 078	47 888	48 846	49 823	50 961	51 838	52 875	53 932	55 165	56 114	57 237	58 381	59 715	60 743	61 958	63 197	64 641	65 754	67 069	68 410	69 974	71 178
Total Current Assets		**63 892**	**260 817**	**433 542**	**553 551**	**673 197**	**793 109**	**913 451**	**1 033 616**	**1 153 383**	**1 273 437**	**1 341 430**	**1 371 385**	**1 030 821**	**1 114 679**	**1 198 578**	**1 283 041**	**1 366 730**	**1 450 754**	**1 534 823**	**116 354**	**118 357**	**120 724**	**123 139**	**125 952**	**128 121**
Fixed Assets (Gross)		11 187 318	18 929 151	18 929 151	18 929 151	18 929 151	18 929 151	18 929 151	18 929 151	18 929 151	19 095 349	19 095 349	19 095 349	19 095 349	19 095 349	19 095 349	19 095 349	19 095 349	19 290 098	19 290 098	19 290 098	19 290 098	19 290 098	19 290 098	19 290 098	19 290 098
Less Accummulated Depreciation		0	452 376	1 732 354	3 015 839	4 295 816	5 575 794	6 845 772	8 100 832	9 352 463	10 615 742	11 900 589	13 188 957	14 473 804	15 758 652	17 031 873	18 286 933	19 095 349	19 108 999	19 147 922	19 186 952	19 225 875	19 264 798	19 290 098	19 290 098	19 290 098
Fixed Assets (Net)		11 187 318	18 476 775	17 196 797	15 913 312	14 633 335	13 353 357	12 083 378	10 828 318	9 576 688	8 479 607	7 194 760	5 906 392	4 621 545	3 336 697	2 063 476	808 416	0	181 099	142 176	103 146	64 223	25 300	0	0	0
Total Assets		**11 251 210**	**18 737 592**	**17 630 339**	**16 466 863**	**15 306 532**	**14 146 466**	**12 996 829**	**11 861 935**	**10 730 071**	**9 753 044**	**8 536 189**	**7 277 778**	**5 652 366**	**4 451 377**	**3 262 054**	**2 091 457**	**1 366 730**	**1 631 854**	**1 676 999**	**219 501**	**182 580**	**146 024**	**123 139**	**125 952**	**128 121**
LIABILITIES AND EQUITY																										
Accounts Payable		1 610	4 935	11 134	11 337	11 500	11 688	11 881	12 103	12 280	12 486	12 697	12 939	19 495	13 358	13 588	13 853	14 065	14 311	14 563	36 169	15 085	15 354	15 629	15 946	16 200
Total Current Liabilities		**1 610**	**4 935**	**11 134**	**11 337**	**11 500**	**11 688**	**11 881**	**12 103**	**12 280**	**12 486**	**12 697**	**12 939**	**19 495**	**13 358**	**13 588**	**13 853**	**14 065**	**14 311**	**14 563**	**36 169**	**15 085**	**15 354**	**15 629**	**15 946**	**16 200**
Subordinated Debt		2 072 196	3 423 918	3 069 284	2 713 678	2 359 045	2 004 411	1 649 777	1 294 171	939 537	584 903	230 269	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long-Term Debt		8 058 539	13 315 170	11 935 849	10 552 749	9 173 428	7 794 108	6 414 787	5 031 687	3 652 366	2 273 045	893 724	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Liabilities		**10 132 344**	**16 744 023**	**15 016 268**	**13 277 765**	**11 543 973**	**9 810 206**	**8 076 444**	**6 337 961**	**4 604 183**	**2 870 434**	**1 136 690**	**12 939**	**19 495**	**13 358**	**13 588**	**13 853**	**14 065**	**14 311**	**14 563**	**36 169**	**15 085**	**15 354**	**15 629**	**15 946**	**16 200**
Grant from Government		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equity Investment		1 551 081	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787	2 535 787
Retained earnings		-432 215	-542 217	78 284	653 311	1 226 772	1 800 472	2 384 598	2 988 187	3 590 101	4 346 823	4 863 712	4 729 052	3 097 084	1 902 232	712 678	-458 182	-1 183 122	-918 244	-873 351	-2 352 455	-2 368 291	-2 405 116	-2 428 277	-2 425 780	-2 423 866
Total Equity		1 118 866	1 993 569	2 614 071	3 189 098	3 762 559	4 336 259	4 920 385	5 523 974	6 125 888	6 882 610	7 399 499	7 264 839	5 632 871	4 438 018	3 248 465	2 077 604	1 352 664	1 617 542	1 662 436	183 332	167 496	130 671	107 510	110 007	111 921
Total Liabilities and Equity		**11 251 210**	**18 737 592**	**17 630 339**	**16 466 863**	**15 306 532**	**14 146 466**	**12 996 829**	**11 861 935**	**10 730 071**	**9 753 044**	**8 536 189**	**7 277 778**	**5 652 366**	**4 451 377**	**3 262 054**	**2 091 457**	**1 366 730**	**1 631 854**	**1 676 999**	**219 501**	**182 580**	**146 024**	**123 139**	**125 952**	**128 121**

The Hypothetical IP

CONCESSION MODEL: CASH FLOW WATERFALL STATEMENT — NOMINAL PRICES — CONCESSION

	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Revenues		0	1 275 819	3 682 073	3 766 206	3 831 034	3 907 655	3 985 808	4 076 882	4 147 058	4 229 999	4 314 599	4 413 185	4 489 150	4 578 933	4 670 511	4 777 230	4 859 461	4 956 650	5 055 783	5 171 305	5 260 319	5 365 526	5 472 836	5 597 888	5 694 245
Interest Income		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating Expenses		107 336	328 978	742 299	755 828	766 651	779 219	792 070	806 847	818 676	832 410	846 453	862 599	1 299 643	890 543	905 892	923 539	937 681	954 094	970 878	2 411 237	1 005 640	1 023 590	1 041 947	1 063 042	1 079 971
Capex		11 187 318	7 741 832	0	0	0	0	0	0	0	166 199	0	0	0	0	0	0	0	194 749	0	0	0	0	0	0	0
Cash Flow Before Funding		-11 294 654	-6 794 992	2 939 774	3 010 379	3 064 384	3 128 436	3 193 739	3 270 035	3 328 381	3 231 390	3 468 146	3 550 586	3 189 507	3 688 390	3 764 619	3 853 691	3 921 780	3 807 807	4 084 906	2 760 069	4 254 679	4 341 936	4 430 890	4 534 846	4 614 273
Initial Equity Investments (Pre-Operating Phase)		1 381 464	984 706	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Equity Investments (Operating Phase) (calculated below)		169 617	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Debt Issuance		8 058 539	5 744 117	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subordinated Debt Issuance		2 072 196	1 477 059	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grant from Government		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Compensation from government for operating loss		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Income Taxes		0	34 988	169 364	187 674	204 570	222 423	241 965	263 893	281 428	298 308	313 902	336 270	285 699	360 531	373 710	389 795	467 005	598 336	606 897	408 156	632 363	645 452	660 838	680 227	692 141
Increase in Accounts Receivable		0	12 758	24 063	841	648	766	782	911	702	829	846	986	760	898	916	1 067	822	972	991	1 155	890	1 052	1 073	1 251	964
Increase in Inventory		0	15 948	30 078	1 052	810	958	977	1 138	877	1 037	1 057	1 232	950	1 122	1 145	1 334	1 028	1 215	1 239	1 444	1 113	1 315	1 341	1 563	1 204
Increase in Accounts Payable		1 610	3 325	6 200	203	162	189	193	222	177	206	211	242	6 556	-6 136	230	265	212	246	252	21 605	-21 084	269	275	316	254
Cash Flow Available for Debt Service, CFADS		**388 771**	**1 350 521**	**2 722 469**	**2 821 014**	**2 858 518**	**2 904 477**	**2 950 208**	**3 004 314**	**3 045 552**	**2 931 422**	**3 152 551**	**3 212 341**	**2 908 654**	**3 319 702**	**3 389 079**	**3 461 760**	**3 453 137**	**3 207 530**	**3 476 029**	**2 370 919**	**3 599 229**	**3 694 386**	**3 767 912**	**3 852 122**	**3 920 218**
Interest Expense		0	153 878	530 705	475 732	420 608	365 635	310 661	255 688	200 564	145 591	90 617	20 420	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan Principal Repayment		0	487 486	1 379 321	1 383 100	1 379 321	1 379 321	1 379 321	1 383 100	1 379 321	1 379 321	1 379 321	893 724	0	0	0	0	0	0	0	0	0	0	0	0	0
Subordinated Debt Repayment		0	125 336	354 634	355 606	354 634	354 634	354 634	355 606	354 634	354 634	354 634	230 269	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Flow Available for Reserve Accounts		**388 771**	**583 821**	**457 809**	**606 577**	**703 955**	**804 887**	**905 592**	**1 009 921**	**1 111 033**	**1 051 876**	**1 327 979**	**2 067 927**	**2 908 654**	**3 319 702**	**3 389 079**	**3 461 760**	**3 453 137**	**3 207 530**	**3 476 029**	**2 370 919**	**3 599 229**	**3 694 386**	**3 767 912**	**3 852 122**	**3 920 218**
Cash Flow to Debt Service Reserve Account		51 600	93 303	-2 789	-3 427	-3 103	-3 103	-2 789	-3 427	-3 103	-3 103	-44 281	-75 776	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Flow to subordinated debt Service Reserve Account		12 292	31 527	-1 397	-1 563	-1 478	-1 478	-1 397	-1 563	-1 478	-1 478	-12 399	-19 591	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Flow to Maitenance Reserve Account		0	43 390	122 769	123 105	122 769	122 769	122 769	123 105	122 769	122 769	122 769	123 105	-342 274	81 838	81 838	82 062	81 838	81 838	81 838	-1 421 068	0	0	0	0	0
Cash Flow Available for Profit Sharing		**324 880**	**415 601**	**339 225**	**488 461**	**585 767**	**686 699**	**787 008**	**891 805**	**992 845**	**933 688**	**1 261 890**	**2 040 189**	**3 250 928**	**3 237 864**	**3 307 241**	**3 379 698**	**3 371 299**	**3 125 692**	**3 394 191**	**3 791 987**	**3 599 229**	**3 694 386**	**3 767 912**	**3 852 122**	**3 920 218**
Profit Sharing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Flow Available to Pay Dividends		**324 880**	**415 601**	**339 225**	**488 461**	**585 767**	**686 699**	**787 008**	**891 805**	**992 845**	**933 688**	**1 261 890**	**2 040 189**	**3 250 928**	**3 237 864**	**3 307 241**	**3 379 698**	**3 371 299**	**3 125 692**	**3 394 191**	**3 791 987**	**3 599 229**	**3 694 386**	**3 767 912**	**3 852 122**	**3 920 218**
Dividends (Adjusted)		**324 880**	**415 601**	**339 225**	**488 461**	**585 767**	**686 699**	**787 008**	**891 805**	**992 845**	**933 688**	**1 261 890**	**2 040 189**	**3 250 928**	**3 237 864**	**3 307 241**	**3 379 698**	**3 371 299**	**3 125 692**	**3 394 191**	**3 791 987**	**3 599 229**	**3 694 386**	**3 767 912**	**3 852 122**	**3 920 218**
Net Change in Cash		**63 892**	**168 220**	**118 584**	**118 116**	**118 188**	**118 188**	**118 584**	**118 116**	**118 188**	**118 188**	**66 089**	**27 738**	**-342 274**	**81 838**	**81 838**	**82 062**	**81 838**	**81 838**	**81 838**	**-1 421 068**	**0**	**0**	**0**	**0**	**0**
Beginning Cash Balance		0	63 892	232 111	350 695	468 811	586 999	705 187	823 770	941 886	1 060 074	1 178 262	1 244 351	1 272 089	929 815	1 011 653	1 093 491	1 175 554	1 257 392	1 339 230	1 421 068	0	0	0	0	0
Ending Cash Balance		63 892	232 111	350 695	468 811	586 999	705 187	823 770	941 886	1 060 074	1 178 262	1 244 351	1 272 089	929 815	1 011 653	1 093 491	1 175 554	1 257 392	1 339 230	1 421 068	0	0	0	0	0	0

The Hypothetical IP

CONCESSION MODEL: DEBT SERVICE COVER RATIO — NOMINAL PRICES — CONCESSION

	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Calculate Debt Service Cover Ratio, DSCR:																										
Cash Flow Available for Debt Service, CFADS		0	477 308	2 722 469	2 821 014	2 858 518	2 904 477	2 950 208	3 004 314	3 045 552	2 931 422	3 152 551	3 212 341	2 908 654	3 319 702	3 389 079	3 461 760	3 453 137	3 207 530	3 476 029	2 370 919	3 599 229	3 694 386	3 767 912	3 852 122	3 920 218
Debt Payment Due		0	619 197	1 738 830	1 705 368	1 664 245	1 627 003	1 589 762	1 556 299	1 515 176	1 477 935	1 440 693	909 317	0	0	0	0	0	0	0	0	0	0	0	0	0
Debt Service Coverage Ratio, DSCR			0,77	1,57	1,65	1,72	1,79	1,86	1,93	2,01	1,98	2,19	3,53													
Minimum DSCR	**0,77**																									
Average DSCR	**1,91**																									
Calculate Loan Life Cover Ratio, LLCR:																										
Qualifying CFADS		0	477 308	2 722 469	2 821 014	2 858 518	2 904 477	2 950 208	3 004 314	3 045 552	2 931 422	3 152 551	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPV (Qualifying CFADS)		0	22 952 249	23 094 652	20 995 738	18 741 608	16 389 114	13 927 143	11 352 968	8 655 184	5 843 322	3 069 670	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan Balance at start of period		0	3 549 254	3 423 918	3 069 284	2 713 678	2 359 045	2 004 411	1 649 777	1 294 171	939 537	584 903	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan Life Coverage Ratio, LLCR			6,5	6,7	6,8	6,9	6,9	6,9	6,9	6,7	6,2	5,2														
Minimum DSCR	**5,25**																									
Average DSCR	**6,59**																									
Calculate Project Life Cover Ratio, PLCR:																										
Qualifying CFADS		0	477 308	2 722 469	2 821 014	2 858 518	2 904 477	2 950 208	3 004 314	3 045 552	2 931 422	3 152 551	3 212 341	2 908 654	3 319 702	3 389 079	3 461 760	0	0	0	0	0	0	0	0	0	0
NPV (Qualifying CFADS)		0	34 464 562	34 917 798	33 138 109	31 211 824	29 196 025	27 079 841	24 860 789	22 527 716	20 090 412	17 701 431	15 026 819	12 220 202	9 641 493	6 582 112	3 370 750	0	0	0	0	0	0	0	0	0
Loan Balance at start of period		0	3 549 254	3 423 918	3 069 284	2 713 678	2 359 045	2 004 411	1 649 777	1 294 171	939 537	584 903	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Project Life Coverage Ratio, PLCR			9,7	10,2	10,8	11,5	12,4	13,5	15,1	17,4	21,4	30,3														
Minimum DSCR	**9,71**																									
Average DSCR	**15,22**																									

The Hypothetical IP

NOMINAL PRICES — CONCESSION

	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Calculate Equity Cash Flows:																										
Equity Investments		1 551 081	984 706	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dividends		324 880	415 601	339 225	488 461	585 767	686 699	787 008	891 805	992 845	933 688	1 261 890	2 040 189	3 250 928	3 237 864	3 307 241	3 379 698	3 371 299	3 125 692	3 394 191	3 791 987	3 599 229	3 694 386	3 767 912	3 852 122	3 920 218
Equity Cash Flow		-1 226 201	-569 104	339 225	488 461	585 767	686 699	787 008	891 805	992 845	933 688	1 261 890	2 040 189	3 250 928	3 237 864	3 307 241	3 379 698	3 371 299	3 125 692	3 394 191	3 791 987	3 599 229	3 694 386	3 767 912	3 852 122	3 920 218
Base Date for Computing NPV and IRR:	2017-01-01																									
Cost of Equity	12,8%																									
Equity IRR	34,3%	#N/A	#NUM!	-66%	-29%	-8%	5%	13%	18%	22%	24%	26%	28%	30%	31%	32%	33%	33%	34%	34%	34%	34%	34%	34%	34%	34%
NPV on Equity Investment	7 622 653	-1 226 201	-1 730 797	-1 464 116	-1 123 755	-761 856	-385 690	-3 444	380 477	759 447	1 075 440	1 454 098	1 996 729	2 763 371	3 440 381	4 053 512	4 608 871	5 100 055	5 503 835	5 892 598	6 277 566	6 601 546	6 896 397	7 163 029	7 404 641	7 622 653

Equity IRR > Cost of Equity

Equity NPV > 0

Appendix 28

Results of stakeholders' satisfaction (The shadow bid model: revenue generating IP) (prepared by the author of this dissertation)

		NPVt=1	NPVt=2	NPVt=3	NPVt=4	NPVt=5	NPVt=6	NPVt=7	NPVt=8	NPVt=9	NPVt=10	NPVt=11	NPVt=12	NPVt=13	NPVt=14	NPVt=15	NPVt=16	NPVt=17	NPVt=18	NPVt=19	NPVt=20	NPVt=21	NPVt=22	NPVt=23	NPVt=24	NPVt=25
Indicators																										
NPV on Equity Investment	0	-1 226 201	-1 730 797	-1 464 116	-1 123 755	-761 856	-385 690	-3 444	380 477	759 447	1 075 440	1 454 098	1 996 729	2 763 371	3 440 381	4 053 512	4 608 871	5 100 055	5 503 835	5 892 598	6 277 566	6 601 546	6 896 397	7 163 029	7 404 641	7 622 653
Equity IRR	12,8%	#N/A	#NUM!	-66%	-29%	-8%	5%	13%	18%	22%	24%	26%	28%	30%	31%	32%	33%	33%	34%	34%	34%	34%	34%	34%	34%	34%
Average DSCR	1,3		0,77	1,17	1,33	1,43	1,50	1,56	1,61	1,66	1,70	1,75	1,91	1,91	1,91	1,91	1,91	1,91	1,91	1,91	1,91	1,91	1,91	1,91	1,91	1,91
Average LLCR	2,00		6,47	6,61	6,68	6,74	6,78	6,81	6,82	6,80	6,74	6,59	6,59	6,59	6,59	6,59	6,59	6,59	6,59	6,59	6,59	6,59	6,59	6,59	6,59	6,59
Average PLCR	7,00		9,71	9,95	10,24	10,55	10,92	11,35	11,88	12,57	13,55	15,22	15,22	15,22	15,22	15,22	15,22	15,22	15,22	15,22	15,22	15,22	15,22	15,22	15,22	15,22
Tests for satisfaction of indicators																										
NPV on Equity Investment		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Equity IRR		*#N/A*	*#NUM!*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Average DSCR		*1*	*0*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Average DSCR		*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Average DSCR		*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*

Appendix 29

VfM assessment (the revenue generating IP) (prepared by the author of this dissertation)

The Hypothetical IP																										
VALUE FOR MONEY		NOMINAL PRICES		CONCESSION																						
	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Procurement and oversight cost		100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000
Revenue to the public sector		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Income sharing with government		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Profit Sharing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk		3 189 609	1 020 253	1 709 433	1 806 157	1 899 315	1 988 545	2 074 245	2 156 556	2 235 833	2 311 767	2 384 697	2 454 744	2 522 208	2 586 826	2 648 890	2 708 499	2 765 910	2 820 900	2 873 716	2 924 443	2 973 299	3 020 096	3 065 041	3 108 209	3 149 786	3 189 609
Retained risk		3 189 609	1 020 253	1 709 433	1 806 157	1 899 315	1 988 545	2 074 245	2 156 556	2 235 833	2 311 767	2 384 697	2 454 744	2 522 208	2 586 826	2 648 890	2 708 499	2 765 910	2 820 900	2 873 716	2 924 443	2 973 299	3 020 096	3 065 041	3 108 209	3 149 786	3 189 609
Subsidies		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grant from government		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
General compensation for operating loss		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Con (Pu. S.)		3 189 609	1 020 253	1 709 433	1 806 157	1 899 315	1 988 545	2 074 245	2 156 556	2 235 833	2 311 767	2 384 697	2 454 744	2 522 208	2 586 826	2 648 890	2 708 499	2 765 910	2 820 900	2 873 716	2 924 443	2 973 299	3 020 096	3 065 041	3 108 209	3 149 786	3 189 609
Con (PPA)		3 189 609	1 020 253	1 709 433	1 806 157	1 899 315	1 988 545	2 074 245	2 156 556	2 235 833	2 311 767	2 384 697	2 454 744	2 522 208	2 586 826	2 648 890	2 708 499	2 765 910	2 820 900	2 873 716	2 924 443	2 973 299	3 020 096	3 065 041	3 108 209	3 149 786	3 189 609
VfM - Con (Pu. S.)		2 505 609	15 082 867	24 322 946	22 838 760	21 402 111	20 020 542	18 687 998	17 402 966	16 160 052	14 965 539	13 946 394	12 836 796	11 763 729	11 030 907	10 041 456	9 090 406	8 173 492	7 294 888	6 546 232	5 734 726	5 604 624	4 855 165	4 134 986	3 442 968	2 776 012	2 599 279
VfM - Con (Pu. S. including NFBs)		4 219 959	15 677 149	25 488 008	24 552 027	23 116 460	21 734 891	20 402 348	19 117 315	17 874 401	16 679 889	15 660 744	14 551 146	13 478 079	12 745 256	11 755 806	10 804 756	9 887 842	9 009 237	8 260 581	7 449 075	7 318 974	6 569 514	5 849 335	5 157 318	4 490 362	4 313 629
VfM - Con (PPA)		4 219 959	15 677 149	25 488 008	24 552 027	23 116 460	21 734 891	20 402 348	19 117 315	17 874 401	16 679 889	15 660 744	14 551 146	13 478 079	12 745 256	11 755 806	10 804 756	9 887 842	9 009 237	8 260 581	7 449 075	7 318 974	6 569 514	5 849 335	5 157 318	4 490 362	4 313 629
VfM - Con (Users)		1 714 350	594 282	1 165 061	1 713 268	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350

Appendix 30

Key-inputs different from the former scenario (the non-revenue generating IP)

(prepared by the author of this dissertation)

Taxes

21,00%	**VAT**	
0	Possibility to recover VAT	<<< Enter 1 (TRUE) or 0 (FALSE)
15,00%	**Profit tax**	
1	PSC: Profit tax for the public sector company applied?	<<< Enter 1 (TRUE) or 0 (FALSE)
0	Tax Holiday (year tax holiday ends)	
0	PPP: Nonprofit organization (NPO) // non-business entity?	<<< Enter 1 (Nonprofit) or 0 (business entity)
0	Allow Tax Holiday?	<<< Enter 1 (TRUE) or 0 (no tax holiday)
5	Tax Holiday (year tax holiday ends)	
1,00%	**Real estate tax**	
1	Allow Tax Holiday?	<<< Enter 1 (TRUE) or 0 (no tax holiday)
26	Tax Holiday (year tax holiday ends)	
0,40%	**Land rent tax**	
1 500 000	Base for land tax (€)	
6 000	Land rent tax per year (€)	
16	Land rent tax per day (€)	
1	Allow land tax holiday?	<<< Enter 1 (TRUE) or 0 (no tax holiday)
26	Tax Holiday (year tax holiday ends)	
0	**PPP contract implementation monitoring tax per year (€ per unit without VAT)**	
0	PPP contract implementation monitoring tax per day (€ per unit without VAT)	
0	Is PPP contract monitoring tax required?	<<< Enter 1 (TRUE) or 0 (no monitoring tax required)

27 Business accounting standard (BAS)

100%	Market price and cost of construction ratio

138 476	Payment viriable

Annual payment coefficent	*Part*
11,4	P2 - Equity, P3 - Credit
0,9	P3 - Administration
1,3	P1 - Maitenance
1,7	P5 - Services
0,9	P6 - Minucipality taxes

Annual payment	*Margin*	*Part*
1 583 908	27%	P2 - Equity, P3 - Credit
121 594	27%	P3 - Administration
177 057	27%	P1 - Maitenance
241 698	27%	P5 - Services
120 282	26%	P6 - Minucipality taxes

Appendix 31

Cash flows if the hypothetical IP (the non-revenue generating IP) (prepared by the author of this dissertation)

The Hypothetical IP PUBLIC SECTOR: DAYS AND INFLATION																											
Period begins:	16.06.01	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:	16.12.31	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Project year	X	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Design																										
Days in period	214	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365
Days of design in period		150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inflation factors																										
Inflation Factor:	1,012	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020	1,020
Cumulative inflation factor:	1,012	1,032	1,053	1,074	1,095	1,117	1,139	1,162	1,186	1,209	1,233	1,258	1,283	1,309	1,335	1,362	1,389	1,417	1,445	1,474	1,504	1,534	1,565	1,596	1,628	1,660
Inflation Factor for expense of energy, water and waste disposal	1,018	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030
Cumulative Inflation Factor:	1,018	1,048	1,080	1,112	1,145	1,180	1,215	1,252	1,289	1,328	1,368	1,409	1,451	1,495	1,540	1,586	1,633	1,682	1,733	1,785	1,839	1,894	1,951	2,009	2,070	2,132
Construction of parking plots																										
Days of parking plots in period		215	145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Installation of parking equipment																										
Days of quipment installation in period		0	91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operation																										
Days for operation left in period		0	129	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365
Repair																										
Is medium repair needed?		FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
Is major repair needed?		FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE
Depreciation, summary																										
Parking plots		0	129	365	366	365	365	365	366	365	365	365	366	365	365	365	366	236	0	0	0	0	0	0	0	0
Equipment		0	129	365	366	365	365	365	366	365	236	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equipment (reinvestments 1)		0	0	0	0	0	0	0	0	0	128	365	366	365	365	365	366	365	237	0	0	0	0	0	0	0
Equipment (reinvestments 2)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	128	365	366	365	365	365	366	365
Debt repayment																										
Repayment days in period		0	129	365	366	365	365	365	366	365	365	365	237	0	0	0	0	0	0	0	0	0	0	0	0	0
External impact																										
Days of operation		365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365
Days of service being delayed		1096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096	1 096
Days left for being delayed		731	366	1	-365	-730	-1095	-1460	-1826	-2191	-2556	-2921	-3287	-3652	-4017	-4382	-4748	-5113	-5478	-5843	-6209	-6574	-6939	-7304	-7670	-8035
Days in period the external impact is assessed		365	365	365	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The Hypothetical IP

PUBIC SECTOR: CAPEX — NOMINAL PRICES — VAT included

Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
TEST (Used to determine time for reinvestments 1)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TEST (Used to determine time for reinvestments 2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Construction of parking plots:																									
Multi-level parking plots	10 354 004	7 122 592	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ground parking plots	591 657	407 005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parking plots, total	10 945 662	7 529 597	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional cost of parking plots construction:																									
Design	154 794	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Development fees	164 185	112 944	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advisory fees	54 728	37 648	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insurance	164 185	112 944	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Contingency	1 094 566	752 960	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional cost, total	1 632 458	1 016 496	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parking garage, total	15 219 525	10 340 772	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Instalation of parking equipment:																									
Equipment	0	138 848	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Instalation and adjustment	0	20 827	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Instalation of parking equipment, total	0	193 208	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reinvestments:																									
Renewal and reinvestments of parking equipment 1	0	0	0	0	0	0	0	0	0	187 106	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Renewal and reinvestments of parking equipment 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	219 248	0	0	0	0	0	0	0
Reinvestments, total	0	0	0	0	0	0	0	0	0	226 398	0	0	0	0	0	0	0	265 290	0	0	0	0	0	0	0
Capex: total investments	15 219 525	10 533 980	0	0	0	0	0	0	0	226 398	0	0	0	0	0	0	0	265 290	0	0	0	0	0	0	0

The Hypothetical IP

PUBIC SECTOR: CAPEX AND DEPRECIATION — NOMINAL PRICES — VAT included

Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Compute gross fixed assets: <<< IDC is not calculated																									
Gross Fixed Assets: Parking garage	15 219 525	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297	25 560 297
Gross Fixed Assets: Equipment (investment)	0	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208
Gross Fixed Assets: Equipment (reinvestment 1)	0	0	0	0	0	0	0	0	0	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106
Gross Fixed Assets: Equipment (reinvestment 2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	219 248	219 248	219 248	219 248	219 248	219 248	219 248	219 248
Gross Fixed Assets, total	15 219 525	25 753 505	25 753 505	25 753 505	25 753 505	25 753 505	25 753 505	25 753 505	25 753 505	25 940 610	25 940 610	25 940 610	25 940 610	25 940 610	25 940 610	25 940 610	25 940 610	26 159 858	26 159 858	26 159 858	26 159 858	26 159 858	26 159 858	26 159 858	26 159 858
Calculate depreciation expense:																									
Depreciation expense: parking garage	0	150 458	425 713	426 880	425 713	425 713	425 713	426 880	425 713	425 713	425 713	426 880	425 713	425 713	425 713	426 880	274 964	0	0	0	0	0	0	0	0
Depreciation expense: equipment (investment)	0	8 530	24 134	24 201	24 134	24 134	24 134	24 201	24 134	15 605	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depreciation expense: equipment (reinvestment 1)	0	0	0	0	0	0	0	0	0	8 196	23 372	23 436	23 372	23 372	23 372	23 436	23 372	15 176	0	0	0	0	0	0	0
Depreciation expense: equipment (reinvestment 2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9 604	27 387	27 462	27 387	27 387	27 387	27 462	27 387
Depreciation expense, total	0	158 987	449 848	451 080	449 848	449 848	449 848	451 080	449 848	449 514	449 086	450 316	449 086	449 086	449 086	450 316	298 336	24 780	27 387	27 462	27 387	27 387	27 387	27 462	27 387
Calculate accumulated depreciation:																									
Depreciation expense: parking garage	0	150 458	576 171	1 003 051	1 428 764	1 854 477	2 280 191	2 707 070	3 132 784	3 558 497	3 984 211	4 411 090	4 836 804	5 262 517	5 688 230	6 115 110	6 390 074	6 390 074	6 390 074	6 390 074	6 390 074	6 390 074	6 390 074	6 390 074	6 390 074
Depreciation expense: equipment (investment)	0	8 530	32 664	56 865	80 999	105 133	129 268	153 468	177 603	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208	193 208
Depreciation expense: equipment (reinvestment 1)	0	0	0	0	0	0	0	0	0	8 196	31 568	55 005	78 377	101 749	125 121	148 558	171 930	187 106	187 106	187 106	187 106	187 106	187 106	187 106	187 106
Depreciation expense: equipment (reinvestment 2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9 604	36 991	64 454	91 841	119 228	146 615	174 078	201 465
Depreciation expense, total	0	158 987	608 835	1 059 915	1 509 763	1 959 611	2 409 459	2 860 539	3 310 387	3 759 901	4 208 987	4 659 303	5 108 388	5 557 474	6 006 559	6 456 875	6 755 212	6 779 992	6 807 379	6 834 841	6 862 228	6 889 616	6 917 003	6 944 465	6 971 852
Calculate net fixed assets																									
Gross fixed assets	15 219 525	25 753 505	25 753 505	25 753 505	25 753 505	25 753 505	25 753 505	25 753 505	25 753 505	25 940 610	25 940 610	25 940 610	25 940 610	25 940 610	25 940 610	25 940 610	25 940 610	26 159 858	26 159 858	26 159 858	26 159 858	26 159 858	26 159 858	26 159 858	26 159 858
Total accumulated depreciation	0	158 987	608 835	1 059 915	1 509 763	1 959 611	2 409 459	2 860 539	3 310 387	3 759 901	4 208 987	4 659 303	5 108 388	5 557 474	6 006 559	6 456 875	6 755 212	6 779 992	6 807 379	6 834 841	6 862 228	6 889 616	6 917 003	6 944 465	6 971 852
Net fixed assets	15 219 525	25 594 517	25 144 670	24 693 589	24 243 742	23 793 894	23 344 046	22 892 966	22 443 118	22 180 709	21 731 624	21 281 308	20 832 222	20 383 137	19 934 051	19 483 735	19 185 399	19 379 866	19 352 479	19 325 017	19 297 630	19 270 242	19 242 855	19 215 393	19 188 006
Residual value for FNIS calculation																									

The Hypothetical IP

PUBIC SECTOR: OPEX NOMINAL PRICES PFI VAT included

Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Salaries / wages	0	40 150	115 875	118 523	120 563	122 974	125 434	128 300	130 508	133 118	135 781	138 883	141 274	144 099	146 981	150 340	152 927	155 986	159 106	162 741	165 543	168 853	172 230	176 166	179 198
Electricity	0	42 464	123 755	127 827	131 302	135 241	139 298	143 882	147 794	152 227	156 794	161 953	166 356	171 347	176 487	182 295	187 250	192 868	198 654	205 190	210 769	217 092	223 605	230 962	237 241
Heating (except electricity) costs	0	132	385	397	408	420	433	447	459	473	487	503	517	532	548	566	582	599	617	638	655	675	695	718	737
Infrastructure maitenance costs:																									
Medium maitenance	0	0	0	0	0	0	0	0	0	0	0	0	471 235	0	0	0	0	0	0	0	0	0	0	0	0
Major maitenance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 578 964	0	0	0	0	0
Maitenance, total	0	0	0	0	0	0	0	0	0	0	0	0	570 194	0	0	0	0	0	0	1 910 547	0	0	0	0	0
Other fixed costs:																									
System maitenance services	0	18 737	54 075	55 311	56 263	57 388	58 536	59 873	60 904	62 122	63 364	64 812	65 928	67 246	68 591	70 159	71 366	72 793	74 249	75 946	77 253	78 798	80 374	82 211	83 626
Accounting services	7 178	7 321	7 468	7 638	7 770	7 925	8 083	8 268	8 411	8 579	8 750	8 950	9 104	9 286	9 472	9 689	9 855	10 052	10 253	10 488	10 668	10 882	11 099	11 353	11 548
Audit services	7 219	7 363	7 510	7 682	7 814	7 971	8 130	8 316	8 459	8 628	8 801	9 002	9 157	9 340	9 527	9 744	9 912	10 110	10 312	10 548	10 730	10 944	11 163	11 418	11 615
Insurance services	15 469	15 778	16 094	16 461	16 745	17 080	17 421	17 819	18 126	18 489	18 858	19 289	19 621	20 014	20 414	20 881	21 240	21 665	22 098	22 603	22 992	23 452	23 921	24 467	24 889
Calling center serices	0	4 907	14 163	14 486	14 735	15 030	15 331	15 681	15 951	16 270	16 595	16 975	17 267	17 612	17 964	18 375	18 691	19 065	19 446	19 891	20 233	20 638	21 050	21 531	21 902
Asset management tax	0	8 922	25 750	26 338	26 792	27 328	27 874	28 511	29 002	29 582	30 173	30 863	31 394	32 022	32 662	33 409	33 984	34 664	35 357	36 165	36 787	37 523	38 273	39 148	39 822
Land rent tax per day (€)																									
PPP contract implementation monitoring tax																									
Other administration expense	30 959	31 578	32 210	32 856	33 513	34 183	34 867	35 566	36 277	37 003	37 743	38 500	39 270	40 055	40 856	41 675	42 509	43 359	44 226	45 113	46 016	46 936	47 875	48 835	49 811
Other fixed costs, total	73 597	114 474	190 295	194 534	197 994	201 954	205 993	210 582	214 326	218 613	222 985	227 953	232 006	236 646	241 379	246 756	251 144	256 167	261 291	267 111	271 861	277 299	282 845	289 146	294 287
Other viriable costs:																									
Costs of sand and oil trap services	0	803	2 318	2 370	2 411	2 459	2 509	2 566	2 610	2 662	2 716	2 778	2 825	2 882	2 940	3 007	3 059	3 120	3 182	3 255	3 311	3 377	3 445	3 523	3 584
Costs of permanent repair	0	19 406	56 006	57 286	58 272	59 437	60 626	62 012	63 079	64 341	65 627	67 127	68 282	69 648	71 041	72 664	73 915	75 393	76 901	78 658	80 012	81 612	83 245	85 147	86 612
Maitenance of equipment	0	1 338	3 863	3 951	4 019	4 099	4 181	4 277	4 350	4 437	4 526	4 629	4 709	4 803	4 899	5 011	5 098	5 200	5 304	5 425	5 518	5 628	5 741	5 872	5 973
Cleanning services	0	40 150	115 875	118 523	120 563	122 974	125 434	128 300	130 508	133 118	135 781	138 883	141 274	144 099	146 981	150 340	152 927	155 986	159 106	162 741	165 543	168 853	172 230	176 166	179 198
Wastewater treatment	0	402	1 159	1 185	1 206	1 230	1 254	1 283	1 305	1 331	1 358	1 389	1 413	1 441	1 470	1 503	1 529	1 560	1 591	1 627	1 655	1 689	1 722	1 762	1 792
Other viriable costs, total	0	75 140	216 856	221 811	225 629	230 142	234 745	240 109	244 242	249 126	254 109	259 915	264 389	269 677	275 070	281 356	286 199	291 923	297 761	304 565	309 807	316 003	322 324	329 688	335 363
Operation expenditure, total	**73 597**	**272 360**	**647 166**	**663 093**	**675 896**	**690 731**	**705 902**	**723 319**	**737 329**	**753 558**	**770 156**	**789 208**	**1 374 737**	**822 302**	**840 467**	**861 313**	**878 103**	**897 543**	**917 429**	**2 850 792**	**958 635**	**979 922**	**1 001 698**	**1 026 680**	**1 046 827**

The Hypothetical IP

PUBIC SECTOR: Senior Debt NOMINAL PRICES PFI VAT included

Period begins:	16.06.01	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:	16.12.31	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	X	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
TEST used for bsenior debt repayment period to determine		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senior debt capitalization																										
Beginning Balance in the first period of loan		0	11 026 341	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amount borrowed at beginning of period		10 705 185	7 564 437	453 016	464 165	473 127	483 512	494 132	506 323	516 130	685 969	539 109	552 445	962 316	575 611	588 327	602 919	614 672	813 983	642 200	1 995 555	671 044	685 945	701 189	718 676	732 779
Beginning of period balance, after loan drawdown		10 705 185	18 590 779	453 016	464 165	473 127	483 512	494 132	506 323	516 130	685 969	539 109	552 445	962 316	575 611	588 327	602 919	614 672	813 983	642 200	1 995 555	671 044	685 945	701 189	718 676	732 779
Capitalized interest during construction, total		321 156	360 610	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
End of Period Loan Balance		**11 026 341**	**18 951 389**	**453 016**	**464 165**	**473 127**	**483 512**	**494 132**	**506 323**	**516 130**	**685 969**	**539 109**	**552 445**	**962 316**	**575 611**	**588 327**	**602 919**	**614 672**	**813 983**	**642 200**	**1 995 555**	**671 044**	**685 945**	**701 189**	**718 676**	**732 779**
Senior debt amortization																										
Beginning balance in the first period of loan		0	18 951 389	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beginning balance in the other period of loan		0	0	18 282 058	16 388 217	14 489 186	12 595 345	10 701 503	8 807 661	6 908 631	5 014 789	3 120 947	1 227 106	0	0	0	0	0	0	0	0	0	0	0	0	0
Principal payment		0	669 330	1 893 842	1 899 030	1 893 842	1 893 842	1 893 842	1 899 030	1 893 842	1 893 842	1 893 842	1 227 106	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest expense		0	167 447	457 051	409 705	362 230	314 884	267 538	220 192	172 716	125 370	78 024	19 823	0	0	0	0	0	0	0	0	0	0	0	0	0
Total payment		0	836 778	2 350 893	2 308 736	2 256 071	2 208 725	2 161 379	2 119 222	2 066 557	2 019 211	1 971 865	1 246 929	0	0	0	0	0	0	0	0	0	0	0	0	0
Ending balance		0	18 282 058	16 388 217	14 489 186	12 595 345	10 701 503	8 807 661	6 908 631	5 014 789	3 120 947	1 227 106	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The Hypothetical IP

INITIAL PUBIC SECTOR INVESTMENT PROJECT — NOMINAL PRICES — PFI — VAT included

	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Investment, total	**23 884 830**	**15 219 525**	**10 533 980**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**226 398**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**265 290**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Immovables	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction, reconstruction, other works	23 353 865	15 064 731	10 340 772	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equipment and other long-term assets	171 307	0	193 208	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Design, technical supervisory and other services related to investments in long-term assets (A.1.-A.4.)	145 757	154 794	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Project administration and implementation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other services and costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reinvestments	213 901	0	0	0	0	0	0	0	0	0	226 398	0	0	0	0	0	0	0	265 290	0	0	0	0	0	0	0
Residual value	**4 264 979**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**19 188 006**
Revenue, total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Revenue from goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Revenue from main services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Revenue from additional services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Revenue from financial, investment and other activities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Financial and operating costs, total	**11 437 349**	**73 597**	**439 807**	**1 104 217**	**1 072 798**	**1 038 126**	**1 005 615**	**973 440**	**943 510**	**910 045**	**878 928**	**848 180**	**809 031**	**1 374 737**	**822 302**	**840 467**	**861 313**	**878 103**	**897 543**	**917 429**	**2 850 792**	**958 635**	**979 922**	**1 001 698**	**1 026 680**	**1 046 827**
Operating costs	**9 566 809**	**73 597**	**272 360**	**647 166**	**663 093**	**675 896**	**690 731**	**705 902**	**723 319**	**737 329**	**753 558**	**770 156**	**789 208**	**1 374 737**	**822 302**	**840 467**	**861 313**	**878 103**	**897 543**	**917 429**	**2 850 792**	**958 635**	**979 922**	**1 001 698**	**1 026 680**	**1 046 827**
Raw materials	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salaries/wages	1 516 058	0	40 150	115 875	118 523	120 563	122 974	125 434	128 300	130 508	133 118	135 781	138 883	141 274	144 099	146 981	150 340	152 927	155 986	159 106	162 741	165 543	168 853	172 230	176 166	179 198
Electricity costs	1 771 739	0	42 464	123 755	127 827	131 302	135 241	139 298	143 882	147 794	152 227	156 794	161 953	166 356	171 347	176 487	182 295	187 250	192 868	198 654	205 190	210 769	217 092	223 605	230 962	237 241
Heating (except electricity) costs	5 505	0	132	385	397	408	420	433	447	459	473	487	503	517	532	548	566	582	599	617	638	655	675	695	718	737
Infrastructure maintenance costs	885 070	0	1 338	3 863	3 951	4 019	4 099	4 181	4 277	4 350	4 437	4 526	4 629	574 904	4 803	4 899	5 011	5 098	5 200	5 304	1 915 971	5 518	5 628	5 741	5 872	5 973
Other costs	5 388 436	73 597	188 275	403 289	412 395	419 604	427 996	436 556	446 414	454 218	463 302	472 568	483 238	491 686	501 520	511 550	523 101	532 246	542 890	553 748	566 252	576 151	587 674	599 427	612 962	623 677
Interest on loans (G.3.1.)	1 870 540	0	167 447	457 051	409 705	362 230	314 884	267 538	220 192	172 716	125 370	78 024	19 823	0	0	0	0	0	0	0	0	0	0	0	0	0
Taxes (-negative impact;- positive impact on project cash flows	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total import/purchase VAT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total sales VAT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total sum of other indirect taxes	0																									
Net revenue	**-35 322 179**	**-15 293 122**	**-10 973 786**	**-1 104 217**	**-1 072 798**	**-1 038 126**	**-1 005 615**	**-973 440**	**-943 510**	**-910 045**	**-1 105 325**	**-848 180**	**-809 031**	**-1 374 737**	**-822 302**	**-840 467**	**-861 313**	**-878 103**	**-1 162 833**	**-917 429**	**-2 850 792**	**-958 635**	**-979 922**	**-1 001 698**	**-1 026 680**	**-1 046 827**
Financing, total	**35 322 179**	**15 293 122**	**10 973 786**	**1 104 217**	**1 072 798**	**1 038 126**	**1 005 615**	**973 440**	**943 510**	**910 045**	**1 105 325**	**848 180**	**809 031**	**1 374 737**	**822 302**	**840 467**	**861 313**	**878 103**	**1 162 833**	**917 429**	**2 850 792**	**958 635**	**979 922**	**1 001 698**	**1 026 680**	**1 046 827**
Requested financing	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
EU structural assistance funds	0																									
LT co-financing funds	0																									
Other international financing funds	0																									
Funds of special budgetary programme for VAT financing	0																									
Own funds	**23 803 270**	**4 266 781**	**3 718 069**	**2 545 043**	**2 507 664**	**2 458 840**	**2 415 945**	**2 373 150**	**2 336 218**	**2 287 756**	**2 313 198**	**2 202 912**	**1 483 691**	**412 421**	**246 691**	**252 140**	**258 394**	**263 431**	**348 850**	**275 229**	**855 238**	**287 590**	**293 977**	**300 509**	**308 004**	**314 048**
Public funds (state, municipal budget, other public funds)	23 803 270	4 266 781	3 718 069	2 545 043	2 507 664	2 458 840	2 415 945	2 373 150	2 336 218	2 287 756	2 313 198	2 202 912	1 483 691	412 421	246 691	252 140	258 394	263 431	348 850	275 229	855 238	287 590	293 977	300 509	308 004	314 048
Private funds (own, other private resources)	0																									
Loans	**11 518 909**	**11 026 341**	**7 255 717**	**-1 440 826**	**-1 434 865**	**-1 420 714**	**-1 410 330**	**-1 399 710**	**-1 392 707**	**-1 377 712**	**-1 207 873**	**-1 354 732**	**-674 660**	**962 316**	**575 611**	**588 327**	**602 919**	**614 672**	**813 983**	**642 200**	**1 995 555**	**671 044**	**685 945**	**701 189**	**718 676**	**732 779**
Loans	24 038 288	11 026 341	7 925 048	453 016	464 165	473 127	483 512	494 132	506 323	516 130	685 969	539 109	552 445	962 316	575 611	588 327	602 919	614 672	813 983	642 200	1 995 555	671 044	685 945	701 189	718 676	732 779
Loans reimbursement (not including interest)	12 519 379	0	669 330	1 893 842	1 899 030	1 893 842	1 893 842	1 893 842	1 899 030	1 893 842	1 893 842	1 893 842	1 227 106	0	0	0	0	0	0	0	0	0	0	0	0	0

Financial cash flows:																										
Cash flow for investment FA indicators	-29 186 659	-15 293 122	-10 806 339	-647 166	-663 093	-675 896	-690 731	-705 902	-723 319	-737 329	-979 956	-770 156	-789 208	-1 374 737	-822 302	-840 467	-861 313	-878 103	-1 162 833	-917 429	-2 850 792	-958 635	-979 922	-1 001 698	-1 026 680	18 141 179
Cumulative financial sustainability cash flow		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash flow for capital FA indicators		-4 340 378	-4 554 847	-4 895 936	-4 816 399	-4 714 912	-4 624 670	-4 534 529	-4 455 439	-4 354 314	-4 332 410	-4 174 778	-2 730 620	-412 421	-246 691	-252 140	-258 394	-263 431	-348 850	-275 229	-855 238	-287 590	-293 977	-300 509	-308 004	18 873 958
Cash flow for investment FA indicators without residual value		-15 293 122	-10 806 339	-647 166	-663 093	-675 896	-690 731	-705 902	-723 319	-737 329	-979 956	-770 156	-789 208	-1 374 737	-822 302	-840 467	-861 313	-878 103	-1 162 833	-917 429	-2 850 792	-958 635	-979 922	-1 001 698	-1 026 680	-1 046 827
Cash flow for investment FA indicators by streeing period	-33 451 639	-14 400 303	-23 981 716	-24 522 025	-25 043 311	-25 543 642	-26 025 104	-26 488 416	-26 935 443	-27 364 525	-27 901 509	-28 298 892	-28 682 331	-29 311 259	-29 665 491	-30 006 411	-30 335 391	-30 651 203	-31 045 003	-31 337 557	-32 193 560	-32 464 603	-32 725 490	-32 976 605	-33 218 957	-33 451 639

Financial indicators: NPV of indicators depending on the length of a period	NPV$_{t=0}$	NPV$_{t=2}$	NPV$_{t=3}$	NPV$_{t=4}$	NPV$_{t=5}$	NPV$_{t=6}$	NPV$_{t=7}$	NPV$_{t=8}$	NPV$_{t=9}$	NPV$_{t=10}$	NPV$_{t=11}$	NPV$_{t=12}$	NPV$_{t=13}$	NPV$_{t=14}$	NPV$_{t=15}$	NPV$_{t=16}$	NPV$_{t=17}$	NPV$_{t=18}$	NPV$_{t=19}$	NPV$_{t=20}$	NPV$_{t=21}$	NPV$_{t=22}$	NPV$_{t=23}$	NPV$_{t=24}$	NPV$_{t=25}$
Financial net present value - FNPV(i)	-29 186 659	-69 300	-1 288 403	-3 529 128	-5 630 602	-7 597 254	-9 439 992	-11 166 802	-12 787 088	-14 303 943	-15 747 200	-17 085 874	-18 342 722	-19 780 733	-20 884 819	-21 920 522	-22 893 557	-23 751 124	-24 481 896	-25 166 341	-26 390 868	-27 008 418	-27 595 130	-28 152 624	-28 683 084	-29 186 659
Financial internal rate of return - FIRR(i)	-6,0%	#NUM!	-3,3%	-3,9%	-4,1%	-4,3%	-4,4%	-4,5%	-4,5%	-4,6%	-4,8%	-4,8%	-4,9%	-5,3%	-5,4%	-5,5%	-5,6%	-5,6%	-5,6%	-5,5%	-6,3%	-6,2%	-6,1%	-6,1%	-6,0%	-6,0%
Financial modified internal rate of return - FMIRR(i)	-2,7%	#DIV/0!	-3,3%	-1,9%	-2,6%	-3,0%	-3,2%	-3,3%	-3,3%	-3,4%	-3,4%	-3,4%	-3,4%	-3,7%	-3,5%	-3,5%	-3,5%	-3,5%	-3,4%	-3,2%	-3,6%	-3,1%	-3,0%	-2,9%	-2,8%	-2,7%
Financial cost-benefit ratio	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Financial sustainability (real values)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Appendix 32

Risk assessment and allocation (the non-revenue generating IP) (prepared by the author of this dissertation)

The Hypothetical IP

PUBIC SECTOR: RISK ESTIMATES

NOMINAL PRICES — PFI — VAT included

	Period begins:		17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:		17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	Sum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Investment, total	**8 195 006**	**8 989 993**	**5 245 376**	**3 602 244**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**65 556**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**76 817**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Immovables	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction, reconstruction, other works	8 057 571	8 765 429	5 197 647	3 567 782	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equipment and other long-term assets	30 556	34 462	0	34 462	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Design, technical supervisory and other services related to investments in long-term assets (A.1.-A.4.)	44 943	47 730	47 730	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Project administration and implementation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other services and costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reinvestments	61 937	142 372	0	0	0	0	0	0	0	0	0	65 556	0	0	0	0	0	0	0	76 817	0	0	0	0	0	0	0
Residual value insert viriable for simulation of length period	559 139	2 515 550	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2 515 550
Revenue, total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Revenue from goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Revenue from services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Revenue from financial, investment and other activities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Financial and operating costs, total	**3 803 152**	**8 537 977**	**27 636**	**121 143**	**294 521**	**295 166**	**294 623**	**294 858**	**295 218**	**296 422**	**296 332**	**297 091**	**297 987**	**298 582**	**516 214**	**308 774**	**315 595**	**323 423**	**329 728**	**337 028**	**344 495**	**1 070 473**	**359 968**	**367 961**	**376 138**	**385 518**	**393 084**
Operating costs	**3 592 339**	**8 245 519**	**27 636**	**102 271**	**243 011**	**248 991**	**253 799**	**259 370**	**265 066**	**271 606**	**276 867**	**282 961**	**289 194**	**296 348**	**516 214**	**308 774**	**315 595**	**323 423**	**329 728**	**337 028**	**344 495**	**1 070 473**	**359 968**	**367 961**	**376 138**	**385 518**	**393 084**
Raw materials	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salaries/wages	569 280	1 273 276	0	15 076	43 511	44 505	45 271	46 177	47 100	48 177	49 006	49 986	50 986	52 151	53 048	54 109	55 191	56 453	57 424	58 573	59 744	61 109	62 361	63 404	64 673	66 150	67 289
Electricity costs	665 288	1 525 528	0	15 945	46 470	47 999	49 304	50 783	52 307	54 028	55 497	57 161	58 876	60 814	62 467	64 341	66 271	68 452	70 313	72 422	74 595	77 049	79 144	81 518	83 964	86 726	89 084
Heating (except electricity) costs	2 067	4 740	0	50	144	149	153	158	163	168	172	178	183	189	194	200	206	213	218	225	232	239	246	253	261	269	277
Infrastructure maintenance costs	332 344	973 895	0	503	1 450	1 484	1 509	1 539	1 570	1 606	1 634	1 666	1 700	1 738	215 876	1 804	1 840	1 882	1 914	1 952	1 991	719 448	2 072	2 113	2 156	2 205	2 243
Other costs	2 023 359	4 470 081	27 636	70 697	151 435	154 854	157 562	160 713	163 927	167 628	170 559	173 970	177 449	181 456	184 628	188 321	192 087	196 424	199 858	203 855	207 933	212 628	216 345	220 672	225 085	230 167	234 191
Interest on loans (G.3.1.)	210 813	292 458	0	18 872	51 510	46 174	40 824	35 488	30 152	24 816	19 465	14 129	8 793	2 234	0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenue	**-11 998 158**	**-17 527 970**	**-5 273 012**	**-3 723 387**	**-294 521**	**-295 166**	**-294 623**	**-294 858**	**-295 218**	**-296 422**	**-296 332**	**-362 646**	**-297 987**	**-298 582**	**-516 214**	**-308 774**	**-315 595**	**-323 423**	**-329 728**	**-413 845**	**-344 495**	**-1 070 473**	**-359 968**	**-367 961**	**-376 138**	**-385 518**	**-393 084**
Risk group																											
Design risks	44 943	47 730	47 730	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired construction quality risks	8 057 571	8 765 429	5 197 647	3 567 782	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired services quality risks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired equipment quality risks	30 556	34 462	0	34 462	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Financial accessibility risks	210 813	292 458	0	18 872	51 510	46 174	40 824	35 488	30 152	24 816	19 465	14 129	8 793	2 234	0	0	0	0	0	0	0	0	0	0	0	0	0
Availability risks	3 592 339	8 245 519	27 636	102 271	243 011	248 991	253 799	259 370	265 066	271 606	276 867	282 961	289 194	296 348	516 214	308 774	315 595	323 423	329 728	337 028	344 495	1 070 473	359 968	367 961	376 138	385 518	393 084
Demand risks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value risks	621 076	2 657 922	0	0	0	0	0	0	0	0	0	65 556	0	0	0	0	0	0	0	76 817	0	0	0	0	0	0	2 515 550
Total value of risk in period	12 557 298	20 043 520	5 273 012	3 723 387	294 521	295 166	294 623	294 858	295 218	296 422	296 332	362 646	297 987	298 582	516 214	308 774	315 595	323 423	329 728	413 845	344 495	1 070 473	359 968	367 961	376 138	385 518	2 908 634
Residual value for risk assessment, year			15 219 525	25 594 517	25 144 670	24 693 589	24 243 742	23 793 894	23 344 046	22 892 966	22 443 118	22 180 709	21 731 624	21 281 308	20 832 222	20 383 137	19 934 051	19 483 735	19 185 399	19 379 866	19 352 479	19 325 017	19 297 630	19 270 242	19 242 855	19 215 393	19 188 006
NPV of Risk values depending on the length of a period																											
Design risks			44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943	44 943
Acquired construction quality risks			4 894 206	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571	8 057 571
Acquired services quality risks			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired equipment quality risks			0	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556	30 556
Financial accessibility risks			0	16 732	59 738	96 038	126 257	150 994	170 783	186 120	197 448	205 190	209 728	210 813	210 813	210 813	210 813	210 813	210 813	210 813	210 813	210 813	210 813	210 813	210 813	210 813	210 813
Availability risks			26 022	116 701	319 587	515 330	703 204	883 993	1 057 967	1 225 826	1 386 946	1 542 000	1 691 217	1 835 199	2 071 361	2 204 375	2 332 391	2 455 923	2 574 510	2 688 647	2 798 501	3 119 930	3 221 707	3 319 670	3 413 964	3 504 967	3 592 339
Demand risks			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value risks			1 878 796	62	2 752 172	2 545 009	2 352 774	2 174 310	2 008 666	1 854 851	1 712 244	1 629 354	1 505 950	1 391 446	1 285 375	1 187 070	1 095 983	1 011 548	940 523	922 361	870 984	822 671	777 243	734 528	694 361	656 590	621 076
NPV of risk depending on the length of a period			6 843 968	8 266 565	11 264 566	11 289 446	11 315 305	11 342 367	11 370 485	11 399 866	11 429 708	11 509 613	11 539 964	11 570 527	11 700 619	11 735 327	11 772 257	11 811 353	11 858 916	11 954 890	12 013 367	12 286 483	12 342 833	12 398 080	12 452 208	12 505 440	12 557 298

The Hypothetical IP

PUBIC SECTOR: RETAIN OBLIGATION AND PAYMENT — NOMINAL PRICES — PFI — VAT included

	Period begins:	16.06.01	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	16.12.31	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

Risk factorsand their allocation	Private	Public
Design risks	**75,0%**	**25%**
RF1: Occasional restriction on the land transferred to implementation of the IP that have not been known in advance	0%	100%
RF2: Errors in project design	100%	0%
RF3: Delay of design work	100%	0%
RF4: Cost-overrrun of design work	100%	0%
Acquired construction quality risks	**75,0%**	**25%**
RF1: Occasional restrictions on the work of the contract due to the requirements of archaeological and cultural heritage protection that have not been known in advance	0%	100%
RF2: Quality of contruction is not ensured due to a lack of resources	100%	0%
RF3: Delay of construction work	100%	0%
RF4: Cost-overrrun of construction work	100%	0%
Acquired services quality risks	**75,0%**	**25%**
RF1: The duration of the services is deviating from the plan	100%	0%
RF2: The price of the services is deviating from the predetermined value	100%	0%
RF3: Changes of requirements from the public sector for quality of services	0%	100%
RF4: Cost-overrrun of construction work	100%	0%
Acquired equipment quality risks	**100,0%**	**0%**
RF1: Delay to acquire the equipment	100%	0%
FR1:Delay to install equipment due to a lack of human resources	100%	0%
RF3: Changes of requirements from the public sector for quality of services	100%	0%
RF4: Damage done to the third parties by installing the equipment	100%	0%
Financial accessibility risks	**100,0%**	**0%**
RF1: Increase of financing needed due to cost overrun	100%	0%
RF2: interest rate changes	100%	0%
RF3: Increase of financing needed due to chages in taxation sytem (excluding VAT)	100%	0%
RF4: Non-compliance of the terms and conditions of the main loan	100%	0%
Availability risks	**100,0%**	**0%**
RF1: Use of low-quality materials and equipment	100%	0%
RF2: Damange made to the third parties	100%	0%
RF3: Necessary permissions (licenses) are not obtained	100%	0%
e availability of services or infrastructure is not ensured due to a lack of human res	100%	0%
Demand risks	**50,0%**	**50%**
RF1: Aging of technologies	100%	0%
RF2: Delay to start providing the services	100%	0%
RF3: Changes of competition in the market	0%	100%
RF4: Changes in pricing	0%	100%
Residual value risks	**100,0%**	**0%**
RF1: Deviation from the property maintenance plan	100%	0%
RF2: Inaccurate plan of maintenance costs	100%	0%
RF3: Lack of information on the use of property during the operation period	100%	0%
RF4: Restrictions on the management, use and disposal rights of transferred / returned assets due to transactions with third parties	100%	0%

NPV of risk groups	Private	Public
Design risks	33 707	11 236
Acquired construction quality risks	6 043 178	2 014 393
Acquired services quality risks	0	0
Acquired equipment quality risks	30 556	0
Financial accessibility risks	210 813	0
Availability risks	3 592 339	0
Demand risks	0	0
Residual value risks	621 076	0
Total	**10 531 669**	**2 025 629**

Private	Public
84%	16%

Risk retained by the Public sector in period	NPV																													
Design risks	11 236		11 932	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired condruction quality risks	2 014 393		1 299 412	891 946	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired services quality risks	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquired equipment quality risks	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Financial accessibility risks	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Availability risks	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Demand risks	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value risks	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**2 025 629**		**1 311 344**	**891 946**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Transferred risk			**3 961 668**	**2 831 441**	**294 521**	**295 166**	**294 623**	**294 858**	**295 218**	**296 422**	**296 332**	**362 646**	**297 987**	**298 582**	**516 214**	**308 774**	**315 595**	**323 423**	**329 728**	**413 845**	**344 495**	**1 070 473**	**359 968**	**367 961**	**376 138**	**385 518**	**2 908 634**

Appendix 33

Calculation of $FOPS_{max}$, $FOPS_{rtn}$, MP_{pr} and risk values (the non-revenue generating IP) (prepared by the author of this dissertation)

The Hypothetical IP

PUBIC SECTOR: MAXIMUM OBLIGATION — NOMINAL PRICES — PFI — VAT included

Payments calculation																													
Period begins:		17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:		17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Period number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Part of days for operation in the full year		0,00	0,35	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Index of inflation		1	1	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02
Cumulative index of inflation		1	1	1,02	1,04	1,06	1,08	1,10	1,13	1,15	1,17	1,20	1,22	1,24	1,27	1,29	1,32	1,35	1,37	1,40	1,43	1,46	1,49	1,52	1,55	1,58
Maximum obligations of the public sector	**NPV**																									
Based on actual actual cost	46 008 936	20 566 134	14 529 726	941 687	958 259	970 519	985 589	1 001 121	1 019 741	1 033 661	1 342 602	1 068 143	1 087 789	1 890 951	1 131 076	1 156 062	1 184 736	1 207 831	1 576 677	1 261 923	3 921 265	1 318 602	1 347 883	1 377 836	1 412 198	3 955 461

The Hypothetical IP

PUBIC SECTOR: RETAIN OBLIGATION AND PAYMENT — NOMINAL PRICES — PFI — VAT included

Period begins:	16.06.01	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
Period ends:	16.12.31	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Retained obligation of the public sector in the PPP																										
Retained obligation of the public sector in the PPP	2 025 629	1 311 344	891 946	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VAT of retained obligation of the public sector in the PPP	351 787	227 835	154 800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

NPV of values depending on the length of a period			NPVt=1	NPVt=2	NPVt=3	NPVt=4	NPVt=5	NPVt=6	NPVt=7	NPVt=8	NPVt=9	NPVt=10	NPVt=11	NPVt=12	NPVt=13	NPVt=14	NPVt=15	NPVt=16	NPVt=17	NPVt=18	NPVt=19	NPVt=20	NPVt=21	NPVt=22	NPVt=23	NPVt=24	NPVt=25
Retained obligation of the public sector in the PPP			1 234 787	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629	2 025 629
VAT			214 534	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787	351 787
Maximum payment to the private sector in the PPP based on actual costs			18 130 687	30 222 591	31 008 791	31 762 120	32 480 545	33 167 532	33 824 607	34 454 830	35 056 360	35 792 062	36 343 199	36 871 706	37 736 797	38 224 043	38 692 929	39 145 490	39 579 889	40 113 840	40 516 249	41 693 681	42 066 501	42 425 353	42 770 760	43 104 115	43 983 308
VAT based on actual costs			3 130 801	5 177 824	5 202 475	5 226 463	5 249 675	5 272 196	5 294 049	5 315 310	5 335 882	5 383 606	5 402 970	5 421 810	5 502 308	5 519 983	5 537 126	5 553 800	5 569 927	5 605 675	5 620 844	5 772 548	5 786 819	5 800 659	5 814 082	5 827 138	5 936 716

Appendix 34

Calculation of PSC of the PPA and the public sector (the non-revenue generating IP) (prepared by the author of this dissertation)

The Hypothetical IP

VALUE FOR MONEY NOMINAL PRICES PFI

	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
PSC (Pu. S.)		NPV=1	NPV=2	NPV=3	NPV=4	NPV=5	NPV=6	NPV=7	NPV=8	NPV=9	NPV=10	NPV=11	NPV=12	NPV=13	NPV=14	NPV=15	NPV=16	NPV=17	NPV=18	NPV=19	NPV=20	NPV=21	NPV=22	NPV=23	NPV=24	NPV=25
Procurement and oversight cost	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**
Net base cost	**28 853 054**	**11 913 104**	**19 866 984**	**20 389 305**	**20 893 097**	**21 376 507**	**21 841 557**	**22 288 952**	**22 720 498**	**23 134 607**	**23 635 538**	**24 018 836**	**24 388 577**	**24 958 983**	**25 300 364**	**25 628 822**	**25 945 679**	**26 249 767**	**26 616 604**	**26 898 130**	**27 643 842**	**27 904 511**	**28 155 336**	**28 396 692**	**28 629 552**	**28 853 054**
Raw cost	28 853 054	11 913 104	19 866 984	20 389 305	20 893 097	21 376 507	21 841 557	22 288 952	22 720 498	23 134 607	23 635 538	24 018 836	24 388 577	24 958 983	25 300 364	25 628 822	25 945 679	26 249 767	26 616 604	26 898 130	27 643 842	27 904 511	28 155 336	28 396 692	28 629 552	28 853 054
Capex	19 739 529	11 843 804	19 562 751	19 562 751	19 562 751	19 562 751	19 562 751	19 562 751	19 562 751	19 562 751	19 665 279	19 665 279	19 665 279	19 665 279	19 665 279	19 665 279	19 665 279	19 739 529	19 739 529	19 739 529	19 739 529	19 739 529	19 739 529	19 739 529	19 739 529	19 739 529
Opex	9 113 525	69 300	304 233	826 554	1 330 346	1 813 755	2 278 806	2 726 201	3 157 747	3 571 856	3 970 259	4 353 557	4 723 298	5 293 704	5 635 085	5 963 543	6 280 400	6 584 488	6 877 075	7 158 601	7 904 314	8 164 982	8 415 807	8 657 163	8 890 024	9 113 525
Total revenue	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Main services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk	**10 867 379**	**4 107 036**	**6 851 624**	**7 090 852**	**7 316 401**	**7 528 205**	**7 727 620**	**7 915 448**	**8 092 863**	**8 259 712**	**8 446 759**	**8 595 234**	**8 735 160**	**8 949 347**	**9 077 536**	**9 200 872**	**9 319 852**	**9 434 037**	**9 565 403**	**9 671 116**	**9 951 132**	**10 049 013**	**10 143 197**	**10 233 827**	**10 321 266**	**10 867 379**
Retained risk	1 673 841	1 020 253	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841
Transferable risk	9 193 538	3 086 782	5 177 783	5 417 010	5 642 560	5 854 364	6 053 779	6 241 607	6 419 021	6 585 871	6 772 918	6 921 393	7 061 319	7 275 506	7 403 695	7 527 031	7 646 011	7 760 196	7 891 562	7 997 275	8 277 290	8 375 171	8 469 356	8 559 986	8 647 425	9 193 538
Competitive neutrality	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Profit tax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other taxes and obligations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PSC (Pu. S.)	**39 770 433**	**16 070 140**	**26 768 608**	**27 530 157**	**28 259 498**	**28 954 712**	**29 619 177**	**30 254 400**	**30 863 361**	**31 444 319**	**32 132 297**	**32 664 071**	**33 173 737**	**33 958 330**	**34 427 901**	**34 879 694**	**35 315 531**	**35 733 804**	**36 232 007**	**36 619 246**	**37 644 974**	**38 003 524**	**38 348 533**	**38 680 519**	**39 000 818**	**39 770 433**
NFBs, Total	**1 714 350**	594 282	1 165 061	1 713 268	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	1 714 350	**1 714 350**
PSC (Pu. S. including NFBs)	**41 484 783**	**16 664 422**	**27 933 670**	**29 243 425**	**29 973 848**	**30 669 061**	**31 333 527**	**31 968 749**	**32 577 710**	**33 158 669**	**33 846 647**	**34 378 420**	**34 888 087**	**35 672 680**	**36 142 250**	**36 594 043**	**37 029 881**	**37 448 154**	**37 946 357**	**38 333 595**	**39 359 324**	**39 717 873**	**40 062 883**	**40 394 868**	**40 715 168**	**41 484 783**

PSC (PPA)		NPV=1	NPV=2	NPV=3	NPV=4	NPV=5	NPV=6	NPV=7	NPV=8	NPV=9	NPV=10	NPV=11	NPV=12	NPV=13	NPV=14	NPV=15	NPV=16	NPV=17	NPV=18	NPV=19	NPV=20	NPV=21	NPV=22	NPV=23	NPV=24	NPV=25
Procurement and oversight cost	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**	**50 000**
Net base cost	**28 853 054**	**11 913 104**	**19 866 984**	**20 389 305**	**20 893 097**	**21 376 507**	**21 841 557**	**22 288 952**	**22 720 498**	**23 134 607**	**23 635 538**	**24 018 836**	**24 388 577**	**24 958 983**	**25 300 364**	**25 628 822**	**25 945 679**	**26 249 767**	**26 616 604**	**26 898 130**	**27 643 842**	**27 904 511**	**28 155 336**	**28 396 692**	**28 629 552**	**28 853 054**
Raw cost	28 853 054	11 913 104	19 866 984	20 389 305	20 893 097	21 376 507	21 841 557	22 288 952	22 720 498	23 134 607	23 635 538	24 018 836	24 388 577	24 958 983	25 300 364	25 628 822	25 945 679	26 249 767	26 616 604	26 898 130	27 643 842	27 904 511	28 155 336	28 396 692	28 629 552	28 853 054
Capex	19 739 529	11 843 804	19 562 751	19 562 751	19 562 751	19 562 751	19 562 751	19 562 751	19 562 751	19 562 751	19 665 279	19 665 279	19 665 279	19 665 279	19 665 279	19 665 279	19 665 279	19 739 529	19 739 529	19 739 529	19 739 529	19 739 529	19 739 529	19 739 529	19 739 529	19 739 529
Opex	9 113 525	69 300	304 233	826 554	1 330 346	1 813 755	2 278 806	2 726 201	3 157 747	3 571 856	3 970 259	4 353 557	4 723 298	5 293 704	5 635 085	5 963 543	6 280 400	6 584 488	6 877 075	7 158 601	7 904 314	8 164 982	8 415 807	8 657 163	8 890 024	9 113 525
Total revenue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Main services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk	**10 867 379**	**4 107 036**	**6 851 624**	**7 090 852**	**7 316 401**	**7 528 205**	**7 727 620**	**7 915 448**	**8 092 863**	**8 259 712**	**8 446 759**	**8 595 234**	**8 735 160**	**8 949 347**	**9 077 536**	**9 200 872**	**9 319 852**	**9 434 037**	**9 565 403**	**9 671 116**	**9 951 132**	**10 049 013**	**10 143 197**	**10 233 827**	**10 321 266**	**10 867 379**
Retained risk	1 673 841	1 020 253	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841
Transferable risk	9 193 538	3 086 782	5 177 783	5 417 010	5 642 560	5 854 364	6 053 779	6 241 607	6 419 021	6 585 871	6 772 918	6 921 393	7 061 319	7 275 506	7 403 695	7 527 031	7 646 011	7 760 196	7 891 562	7 997 275	8 277 290	8 375 171	8 469 356	8 559 986	8 647 425	9 193 538
Competitive neutrality	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Profit tax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other taxes and obligations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PSC (PPA)	**41 484 783**	**16 664 422**	**27 933 670**	**29 243 425**	**29 973 848**	**30 669 061**	**31 333 527**	**31 968 749**	**32 577 710**	**33 158 669**	**33 846 647**	**34 378 420**	**34 888 087**	**35 672 680**	**36 142 250**	**36 594 043**	**37 029 881**	**37 448 154**	**37 946 357**	**38 333 595**	**39 359 324**	**39 717 873**	**40 062 883**	**40 394 868**	**40 715 168**	**41 484 783**
NFBs, Total	**1 714 350**	**594 282**	**1 165 061**	**1 713 268**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**
VAT	**6 288 503**	**3 345 334**	**5 529 611**	**5 554 263**	**5 578 250**	**5 601 462**	**5 623 984**	**5 645 836**	**5 667 097**	**5 687 669**	**5 735 394**	**5 754 757**	**5 773 597**	**5 854 095**	**5 871 771**	**5 888 914**	**5 905 587**	**5 921 714**	**5 957 462**	**5 972 632**	**6 124 336**	**6 138 606**	**6 152 446**	**6 165 869**	**6 178 925**	**6 288 503**
PSC (PPA, including VAT and NFBs)	**47 773 286**	**20 009 757**	**33 463 281**	**34 797 687**	**35 552 098**	**36 270 523**	**36 957 510**	**37 614 585**	**38 244 808**	**38 846 338**	**39 582 040**	**40 133 178**	**40 661 684**	**41 526 775**	**42 014 021**	**42 482 957**	**42 935 468**	**43 369 867**	**43 903 819**	**44 306 227**	**45 483 659**	**45 856 479**	**46 215 329**	**46 560 738**	**46 894 093**	**47 773 286**

Appendix 35

VfM results depending on length of the period (the non-revenue generated IP) (prepared by the author of this dissertation)

The Hypothetical IP

VALUE FOR MONEY NOMINAL PRICES PFI

	Period begins:	17.01.01	18.01.01	19.01.01	20.01.01	21.01.01	22.01.01	23.01.01	24.01.01	25.01.01	26.01.01	27.01.01	28.01.01	29.01.01	30.01.01	31.01.01	32.01.01	33.01.01	34.01.01	35.01.01	36.01.01	37.01.01	38.01.01	39.01.01	40.01.01	41.01.01
	Period ends:	17.12.31	18.12.31	19.12.31	20.12.31	21.12.31	22.12.31	23.12.31	24.12.31	25.12.31	26.12.31	27.12.31	28.12.31	29.12.31	30.12.31	31.12.31	32.12.31	33.12.31	34.12.31	35.12.31	36.12.31	37.12.31	38.12.31	39.12.31	40.12.31	41.12.31
Financial cash flow / Project year	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	

PFI (Prefered bid) option		$NPV_{i=1}$	$NPV_{i=2}$	$NPV_{i=3}$	$NPV_{i=4}$	$NPV_{i=5}$	$NPV_{i=6}$	$NPV_{i=7}$	$NPV_{i=8}$	$NPV_{i=9}$	$NPV_{i=10}$	$NPV_{i=11}$	$NPV_{i=12}$	$NPV_{i=13}$	$NPV_{i=14}$	$NPV_{i=15}$	$NPV_{i=16}$	$NPV_{i=17}$	$NPV_{i=18}$	$NPV_{i=19}$	$NPV_{i=20}$	$NPV_{i=21}$	$NPV_{i=22}$	$NPV_{i=23}$	$NPV_{i=24}$	$NPV_{i=25}$	
Procurement and oversight cost	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000
Annual payments	**31 507 421**	**0**	**740 352**	**2 752 300**	**4 684 784**	**6 540 842**	**8 323 497**	**10 035 651**	**11 680 181**	**13 259 673**	**14 776 699**	**16 233 730**	**17 633 214**	**18 977 350**	**20 268 329**	**21 508 252**	**22 699 203**	**23 843 054**	**24 941 667**	**25 996 833**	**27 010 324**	**27 983 732**	**28 918 645**	**29 816 584**	**30 679 057**	**31 507 421**
Additional services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk	**1 673 841**	**1 020 253**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**	**1 673 841**
Retained risk	1 673 841	1 020 253	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841	1 673 841
Subsidies	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Grant from government	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VAT	**6 968 065**	**214 253**	**506 981**	**929 490**	**1 335 311**	**1 725 083**	**2 099 441**	**2 458 993**	**2 804 345**	**3 136 038**	**3 454 614**	**3 760 590**	**4 054 482**	**4 336 750**	**4 607 856**	**4 868 240**	**5 118 339**	**5 358 548**	**5 589 257**	**5 810 842**	**6 023 675**	**6 228 090**	**6 424 422**	**6 612 989**	**6 794 109**	**6 968 065**
PFI - PB cost (Pu. S.)	**33 281 262**	**1 120 253**	**2 514 193**	**4 526 142**	**6 458 625**	**8 314 683**	**10 097 338**	**11 809 492**	**13 454 022**	**15 033 514**	**16 550 541**	**18 007 571**	**19 407 055**	**20 751 192**	**22 042 170**	**23 282 093**	**24 473 044**	**25 616 895**	**26 715 508**	**27 770 674**	**28 784 165**	**29 757 574**	**30 692 486**	**31 590 425**	**32 452 898**	**33 281 262**
PFI - PB cost (PPA)	**40 249 327**	**1 334 507**	**3 021 173**	**5 455 631**	**7 793 937**	**10 039 767**	**12 196 779**	**14 268 485**	**16 258 367**	**18 169 552**	**20 005 154**	**21 768 162**	**23 461 537**	**25 087 942**	**26 650 026**	**28 150 333**	**29 591 383**	**30 975 443**	**32 304 765**	**33 581 516**	**34 807 839**	**35 985 664**	**37 116 908**	**38 203 414**	**39 247 007**	**40 249 327**
VfM - PB (Pu. S.)	**6 489 171**	**14 949 887**	**24 254 415**	**23 004 015**	**21 800 873**	**20 640 028**	**19 521 839**	**18 444 908**	**17 409 339**	**16 410 805**	**15 581 757**	**14 656 499**	**13 766 682**	**13 207 138**	**12 385 730**	**11 597 600**	**10 842 487**	**10 116 909**	**9 516 498**	**8 848 572**	**8 860 809**	**8 245 950**	**7 656 047**	**7 090 094**	**6 547 920**	**6 489 171**
VfM - PB (Pu. S. including NFBs)	**8 203 520**	**15 544 169**	**25 419 477**	**24 717 283**	**23 515 222**	**22 354 378**	**21 236 189**	**20 159 258**	**19 123 688**	**18 125 155**	**17 296 106**	**16 370 849**	**15 481 032**	**14 921 488**	**14 100 080**	**13 311 950**	**12 556 837**	**11 831 259**	**11 230 848**	**10 562 921**	**10 575 159**	**9 960 300**	**9 370 397**	**8 804 444**	**8 262 270**	**8 203 520**
VfM - PB (PPA)	**7 523 959**	**18 675 250**	**30 442 107**	**29 342 056**	**27 758 161**	**26 230 756**	**24 760 732**	**23 346 100**	**21 986 441**	**20 676 786**	**19 576 886**	**18 365 016**	**17 200 148**	**16 438 833**	**15 363 995**	**14 332 624**	**13 344 085**	**12 394 425**	**11 599 053**	**10 724 711**	**10 675 820**	**9 870 815**	**9 098 421**	**8 357 324**	**7 647 086**	**7 523 959**
VfM - PB (Users)	**1 714 350**	**594 282**	**1 165 061**	**1 713 268**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**	**1 714 350**
VfM - PB (Pu. S.)	**16%**	**93%**	**91%**	**84%**	**77%**	**71%**	**66%**	**61%**	**56%**	**52%**	**48%**	**45%**	**41%**	**39%**	**36%**	**33%**	**31%**	**28%**	**26%**	**24%**	**24%**	**22%**	**20%**	**18%**	**17%**	**16%**
VfM - PB (Pu. S. including NFBs)	**20%**	**93%**	**91%**	**85%**	**78%**	**73%**	**68%**	**63%**	**59%**	**55%**	**51%**	**48%**	**44%**	**42%**	**39%**	**36%**	**34%**	**32%**	**30%**	**28%**	**27%**	**25%**	**23%**	**22%**	**20%**	**20%**
VfM - PB (PPA)	**16%**	**93%**	**91%**	**84%**	**78%**	**72%**	**67%**	**62%**	**57%**	**53%**	**49%**	**46%**	**42%**	**40%**	**37%**	**34%**	**31%**	**29%**	**26%**	**24%**	**23%**	**22%**	**20%**	**18%**	**16%**	**16%**

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