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Public Private Partnership for Infrastructure Projects: Mapping the Key Risks

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Abstract**—**In many countries, governments have been promoting the involvement of private sector entities to enter into long-term agreements for the development and delivery of large infrastructure projects, with a focus on overcoming the limitations upon public fund of the traditional approach. The involvement of private sector through public private partnerships (PPP) brings in new capital investments, value for money and additional risks to handle. Worldwide research studies have shown that an objective, systematic, reliable and user-oriented risk assessment process and an optimal allocation mechanism among different stakeholders is crucial to the successful completion. In this framework, this paper, which is the first stage of a research study, aims to identify the main risks for the delivery of PPP projects. A review of cross-countries research projects and case studies was performed to map the key risks affecting PPP infrastructure delivery. The matrix of mapping offers a summary of the frequency of factors, clustered in eleven categories: construction, design, economic, legal, market, natural, operation, political, project finance, project selection and relationship. Results will highlight the most critical risk factors, and will hopefully assist the project managers in directing the managerial attention in the further stages of risk allocation.

Keywords**—**Construction, infrastructure, public private partnerships, risks.

I. Introduction

GOVERNMENTS worldwide are concerned with ways and means to produce infrastructure (including building, transportation and services) in a time of economic uncertainty and increased demand for infrastructure. This situation has led to researching for new approaches such as Public Private Partnerships (PPP). These alternative delivery methods may employ three or more functions such as: Finance (F), Design (D), Build (B), Operate (O), Lease (L), Own (O), Maintain (M), and Transfer (T), mostly adopted in the form of BOT (Build- Operate- Transfer).

According to [1], the acronym BOT was first used by the Turkey's Prime Minister T. Ozal in the early 80's. However, the concept itself can be traced back to Hong Kong in the latest 50's, where a privatized vehicle tunnel was first talked about, an if regarded as a form of concession of franchise agreement has even earlier origins [2].

Akintoye [3] agreed that public financing in developing countries has become very unstable due to the fact that projects for improvement rarely meet crucial infrastructure expenditure requirements in a timely and adequate manner: the situation in Albania is no exception. Most building infrastructure and service suppliers have been funds directly from the fiscal budget, but they are assessed to be in short supply when compared to the country's increasing demand. Even the ones available are not performing to the required standards due to low maintenance and public perceive as "no man's property".

Many studies have recognized that BOT system presents a win-win solution due to the many benefits such as: the reduction of government debt, increase of private sector participation in infrastructure and prevention of tax escalation.

In analogue with worldwide experience, the Albanian government is recently adopting the alternative methods of project delivery by involving the private sector in the provisions of public sector using PPPs. Although private sector is increasingly invoked in the context of developing countries including Albania, various problems have been encountered in this regard due to the short history and lack of PPP experience and expertise. Moreover, even in the developed countries there has been much criticism regarding the system's ability to deliver the promised benefits due to the inherent risks associated with the public private partnership projects. Key features of these approaches include greater risks to handle over the entire life cycle compared to the traditional approach due to their long term nature, their high value and complex organizational structures involved. As a result, a considerable focus is given to the improvement of the systematic risk management (RM) process in every stage of a PPP, starting from the early stage of project planning where key decision are made. As stated by [2], one of the most important benefits of PPP is its ability to transfer the risks from the government the competent private parties by using an effective iterative risk management process including the risk identification, analysis, allocation and monitoring.

This paper analyzes the risks of PPP arrangements from the perspectives of various parties, in different countries. In order to achieve a broad result several research articles focused on PPPs were reviewed, and a risk mapping was performed.

II. Public Private Partnership Development

A. Nature of PPP Projects

The concept of Public Private Partnership is not new: It has been used for as long as private funding has enabled services for the general public, varying in forms between countries. In fact, it is difficult to come out with a single definition of the PPPs due to the different level of private sector involvement or the nature of the responsibilities placed, and many times is confused with the privatization [4]. According to [5], privatization involves a private sector organization providing a facility to the public at a price that is set by the market's

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ability to pay for such a service, while PPP combines the efforts of the public and private sector to provide a facility for public use.

Different definitions have been given for PPP agreements, such as:

"…a contractual agreement of shared ownership between a public agency and a private company, whereby they pool resources together and share risks and rewards, to create efficiency in the production and provision of public or private goods" [3].

"…partnerships between the public sector and the private for the purpose of designing, planning, financing, and constructing and operation of projects which would be regarded traditionally has following within their remit of the public sector" [61].

"… innovative methods used by the public sector to contract with the private sector, who bring their capital and their ability to deliver projects on time and to budget, while the public sector retains the responsibility to provide these services to the public in a way that benefits the public and delivers economic development and an improvement in the quality of life" [58].

Looking at the prepositions of governments PPPs are perceived as long term partnership for mutual benefits:

UK government:

"an arrangement where the private sector partner takes on the responsibility of providing a public service, including maintaining, enhancing or constructing the necessary infrastructure or facility, while the public sector partner specifies the type and quality of the service desired" [8].

Canadian government:

"a co-operative venture between the public and private sectors, built on the expertise of each partner that best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards" [9].

USA government (The National Council for PPP in the United State of America, NCPPP):

"contractual arrangement between a public sector agency and a for-profit private sector concerns whereby resources and risks are shared for the purpose of delivery of a public service or development of public infrastructure" [10].

European Investment bank:

"risk sharing investments in the provision of public goods and services, seen by government as a means to launch investment programs, which would not have been possible within the available public-sector budget within reasonable time" [11].

TABLE I
PUBLIC PRIVATE PARTNERSHIP MODELS

Type/Model	Description of the model
Design-Build (DB)	The government contracts a private partner to design and build a facility in accordance with requirements it sets out. After completing the facility, the government assumes responsibility for operating and maintaining the facility. This method of procurement is also referred to as Build-Transfer (BT)
Design-Build-Maintain (DBM)	This model is similar to Design-Build, except that the private sector also maintains the facility. The public sector retains responsibility for operations
Design-Build-Operate (DBO)	With this model, the private sector designs and builds the facility. Once it is completed, the title for the new facility is transferred to the public sector, but the private sector operates the facility for a specified period. This procurement model is also referred to as Build-Transfer-Operate (BTO).
Design-Build-Operate- Maintain (DBOM)	This model combines the responsibilities of design-build procurements with the operations and maintenance of a facility for a specified period by a private sector partner. At the end of that period, the operation of the facility is transferred back to the public sector. This method of procurement is also referred to as Build-Operate-Transfer (BOT)
Build Operate Transfer (BOT)	PSO enters concession contract to design, build, finance, and operate a public sector facility over an agreed period. PVSO recovers investment over the contract period under the pre negotiated contract terms. The concession period is usually significantly shorter than the operating life of the facility.
Build-Own-Operate- Transfer (BOOT)	The government grants a franchise to a private partner to finance, design, build and operate a facility over a specific period of time. Ownership of the facility is transferred back to the public sector at the end of that period.
Build-Own-Operate (BOO)	The government grants the right to finance, design, build, operate and maintain a project to a private entity, which then retains ownership of the project. The private entity is not required to transfer the facility back to the government
Buy-Build-Operate (BBO)	Transfer of a public asset to a private or quasi-public entity usually under contract that the assets are to be upgraded and operated for a specified period of time. Public control is exercised through the contract at the time of transfer.
Design-Build- Finance-Operate/Maintain (DBFO, DBFM or DBFO/M)	Under this model, the private sector designs, builds, finances, operates and/or maintains a new facility under a long-term lease. At the end of the lease term, the facility is transferred to the public sector. In some countries, DBFO/M covers both BOO and BOOT.
Operate and Maintain (O&M)	Private sector organization (PSO) enters contract to operate a public sector facility on behalf of a public sector organization over an agreed period of time.
Build Lease Transfer (BLT)	Similar to D&B except that the public sector organization pays for the project over a long term lease; Transfer of title is made on completion of payment of lease
Build-Lease-Operate-Transfer (BLOT)	A private entity receives a franchise to finance, design, build and operate a leased facility (and to charge user fees) for the lease period, against payment of a rent.
Finance Only	A private entity, usually a financial services company, funds a project directly or uses various mechanisms such as a long-term lease or bond issue.
Operation License	A private operator receives a license or rights to operate a public service, usually for a specified term. This is often used in IT projects.

Source: Summarized from [57]-[59], [13], [14], [5].

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Through the literature review, it can be noticed that all the definitions share some similarities, which make the main characteristics of PPP agreements:

- Long term agreements, typically from 10-30 or more
- Involvement of two or more participants (including one public and one private)
- Each participant bring something to the partnership
- Optimal sharing of risks and responsibilities between public sector and private sector
- Encourage innovation through producing effective output standards and specifications
- They generally involve performance based payment mechanism
- Generally include private financing, depending on the model adopted
- Generally include fees for the service provided
- Assessment of the investment viability, to demonstrate that the private sector can achieve at least the Minimum Attractive Rate of Return (MARR)
- Provide best' Value for Money' (VFM) by performing Benefit/Cost Analysis over all possible alternatives.

B. Types of PPPs

There are many types of PPPs models depending on the number of stakeholders involved, their contractual agreements, the allocation of risks and responsibilities between public and private partners, and specific project context and content.

Li [7] identified five main types of private engagement such as: leasing, service contracts, joint venture, concession and privatisation. A recent study in UK, performed by Cartlidge [12], nine main models were identified to be implemented.

Reviewing several research projects, the main PPP models are summarized in Table I.

According to [59], for the existing infrastructures, there are several PPP models employed, as given in Table II. Furthermore, recently some new and innovative PPP deliveries have been introduced in specific situations, such as: Alliancing, Bundling, Competitive Partnership, Incremental Partnership, Integrator, etc.

III. PPPs in Albania

Infrastructure development is crucial to supporting the economic recovery after the global crisis, especially in the Western Balkan Region. Assessing the infrastructure investments needs is challenging because of the difficulty of securing reliable and consistent data [15]. A research analysis undertaken by the University of Nice [16], estimated approximately EUR 110 billion infrastructure investment is needed in the region over the next 10 years. In order to fulfill these needs, PPPs are considered as a useful tool helping in the infrastructure gap and improving the overall efficiency through the optimal risk allocation between parties.

The first development of PPPs in Western Balkans dates back to 1998, with the construction and maintenance of a motorway in Croatia. Time by time the number of PPP projects is quickly increasing: Albania is no exception.

TABLE II
Public Private Partnership Models for the Excising Infrastructures [60]

Type/Model	Description of the model
Service Contract Management	The government contracts with a private entity to provide services that the government previously performed
Management Contract	A management contract differs from a service contract in that the private entity is responsible for all aspects of operations and maintenance of the facility under contract.
Lease	The government grants a private entity a leasehold interest in an asset. The private partner operates and maintains the asset in accordance with the terms of the lease.
Concession	The government grants a private entity the exclusive rights to provide operate and maintain an asset over a long period of time in accordance with performance requirements set forth by the government. The public sector retains ownership of the original asset, while the private operator retains ownership over any improvements made during the concession period.
Divestiture	The government transfers an asset, either in part or in full, to the private sector. Generally the government will include certain conditions with the sale of the asset to ensure that improvements are made and citizens continue to be served.

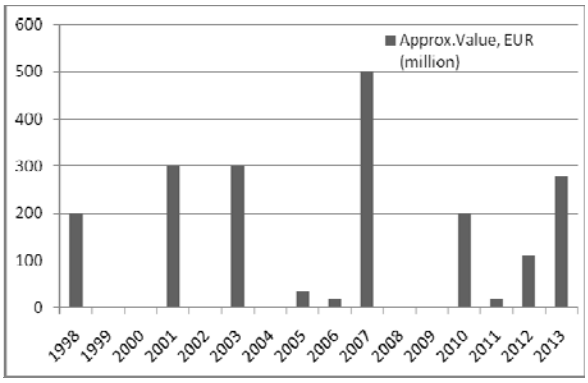


Fig. 1 Mapping PPP projects in Western Balkan Region [15]

TABLE III
Completed and Ongoing PPP Projects in Albania (1998-20013) [15]

Project	Sector	Value (EUR million)
Mother Teresa Airport Terminal (Tirana)	Transportation	34
Bratile Hydropower Plant	Energy	70
TGK Hydropower Plant	Energy	600
Ashta Hydro-Electric Power Project	Energy	160
Devoll Valley Hydropower Project	Energy	n.a
Milot - Morine Highway	Transportation	100
Tirana Public Transport Terminal	Transportation	n.a
Albania solid waste management PPP	Environment	n.a

Signature of the first PPP project in Albania dates in 2005 with Mother Teresa Airport Terminal (Tirana), employing a BOOT model. To date, Albania has seen a number of PPP projects manly in the area of the development and operation of hydropower plans. After the approval of the law no. 125/2013 "On concessions and Public Private Partnerships", the support and the interest shown for various PPP models is expected to be widely expanded in all industry sectors, such as: transportation, public services, healthcare, waste, etc. According to an investigation performed by the European PPP

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Expertise Centre [15] the recent closed and ongoing Public Private Partnership projects are as listed in Table III.

A. Mother Teresa Airport Terminal: A Success Case

In the framework of EU integration of Albania, air transport is considered to be one of the most important transport modes to open and link Albania with Europe and Balkan region countries. In this context, the Albanian government gives priority to improving infrastructure and services of the Tirana International Airport (TIA) [17].

Mother Teresa Airport was built in 1957, 17 km North-West of Tirana, and had the latest upgrade of the runway on 2002. Considered as the first and last impressive image of Albania offered to air passengers as well as a connection point with the world, the government committed for the further development and improvement of its infrastructure.

Performing a roughly competitive analysis for the western Balkan Countries, it is evident that Albania is one with the fewest number, as shown in Table IV.

In this framework the Albanian Government decided to employ a possible Public Private Partnership agreement based on the need:

- To upgrade and improve the existing infrastructure
- To improve security, safety standards and operational standards
- To upgrade the airport handling capacity in compliance with the growing demand
- To introduce the international experience for a new management culture, crucial for every big infrastructure project.

The Concession Agreement was signed in October 2004 by the Albania Government and Tirana Airport Partners (TAP), with the objective to construct, operate and maintain the International Airport "Mother Teresa" of Tirana, specifically including the designing, financing, installation, building, maintaining, operating, managing and developing the new terminal construction based on the old airport. The model adopted is represented in Fig. 2.

TABLE IV
NUMBER OF PPPS IN WESTERN BALKAN COUNTRIES (1998-20013)

Country	Albania		Croatia		FYROM		Kosovo		Montenegro	
Project	Closed	Ongoing	Closed	Ongoing	Closed	Ongoing	Closed	Ongoing	Closed	Ongoing
Number	1	7	19	12	9	6	2	12	5	3

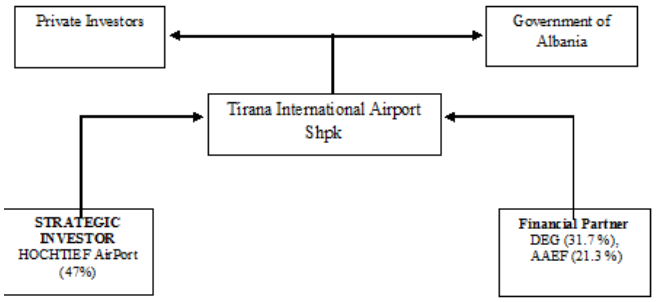


Fig. 2 Concession Structure for International Airport "Mother Teresa" of Tirana

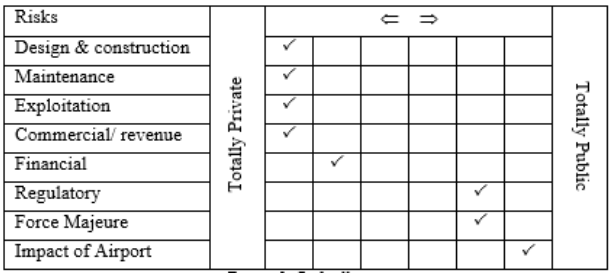


Fig. 3 Risk Allocation in TIA [17]

The model is based on international procurement laws as approved by the Albanian Parliament. After 20 years the airport terminals and associated functions will return to the Ministry of Public Works and Transport. The adoption of the new delivery approach leaded several benefits for Albania, such as: Private initial investment, 30% of all future dividend value, new international experience, creation of job opportunities, etc.

TABLE V
TIA PROJECT OVERVIEW [17]

Tirana International Airport (TIA), Albania	
Project Type:	BOT
Contract duration:	20 Years
Budget:	EUR 50 M (Development)
Project Timeline	
Project conceived:	2003;
Tender:	2004;
Contract Award:	October 2004;
Financial Close:	March 2005;
Contract Ratification:	Nov. 2004 (Law 9312/11.11.2004);
Date of opening:	21-Mar-07

The project was delivered in three main phases:

Phase 1. Construction works (2005-2007), during which were performed the following tasks:

- New Passenger Terminal;
- New Car Parks (Area 1 and 2), covered and uncovered;
- New Air Cargo Centre;
- New Access Road;
- New Bridge on the Existing Road;
- New perimeter road;
- New circulatory road;
- Standardized in-house services and;
- Additional operational facilities (waste water treatment plant, etc.).

Phase 2. New Passenger Terminal (2008-2009) and additional investments in airport facilities and operations, in the extension of apron; in improving the FFR Station, etc.

Phase 3. Following investments in CCTV control system, Access Control system, Emergency Center,

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Preparation of standardized Operation, Maintenance, Security Manuals and others.

The concession is continuing with impressive performance results, being considered a stable basis for the further development of the PPP infrastructure projects in Albania.

IV. Risk Management Process

By the late 90s, it had become clear that a new model for funding infrastructure public project was needed. In developed countries, PPPs have been used since 1990. The European Union registered more than 1,400 PPPs until 2010, with a total value of more than €260 billion [18]. It was assumed that by introducing PPP, projects would be delivered in shorter time spans, and the cost overruns would be minimized. However, the reality has been somewhat different. According to [5], long delays from the pre-contract stage have led to an increase of cost and schedule, whilst some PPP projects have been completed agreed of time and budget.

PPPs have been used successfully in a variety of countries for decades. There is no doubt that each country would have experienced and gradually overcome at least some of the difficulties in introducing PPP. Due to its urgent need to provide new public service facilities, developing countries (including Albania) cannot afford the luxury of gradually learning from its mistakes. For this reason there is a great need to review the existing tools and to develop user oriented models that will identify potential risks and difficulties ate an early stage, so that all parties concerned quickly become aware to the specific approaches that are necessary for a successful PPP.

Managing the risks means maximizing the opportunities and more specifically increasing the probability and the impact of positive events and decreasing the probability and impact of negative events or threats. This statement is sustained by several definitions giver for Risk Management Process (RMP), such as: [19], [58], [60], [20], etc. Generally, literature considers the RM process as a four step approach comprising risk identification, classification, analysis, and response or allocation, being approached as an iterative process. They agreed that the identification phase is one of the most important steps and it should be followed by a proper search for a solution that can optimally allocate the risks to the best parties able to handle them.

Risk allocation, especially in PPP agreements refers to a primary measure of assignment between the public and private sector [6]. The ability to share risks is considered as one of the main advantages public private partnerships.

Referring the Albanian experience in TIA, with respect to risks, the private partner is responsible for providing the financing, construction and modernization by certain deadlines, for the quality of maintenance and service activities, and for the efficient use of the assets transferred from the public authority. On the other hand, the contracting authority has to carry out the project for the development of modern air transport in Albania. Design and construction risks, as well as maintenance risks, are completely assigned to TAP (Tirana Airport Partners). The same applies to the exploitation, commercial/ revenue risks and to a large extent the financial risks.

V. Risk Factors

The main objective of project management is to maintain a good balance between the three pillars of any construction project: cost, time and quality. Anything that may threaten the achievement of these objectives and prevent the project manager from meeting such target is considered a risk to the project [21]. Risk is a multi-face concept. It can be expressed as "the potential for unwanted or negative consequences of an event or activity" [22], "a threat and a challenge" [20], "a combination of probability of an event occurring and its consequences for project objectives" [23]. According to PMI PMBoK [19], [24] risk includes upside effects, the opportunities, but traditionally focuses on the downside, i.e. the negative effects. A review of risks definitions lead to the following faces of project risk: an event that focuses on the future, emphasize the negative effects, deals with the probability and consequences.

A variety of risk definitions have been utilized also in construction projects, and there is not any standard description or methods available to explain the basis on what risk assessment is established. The level and scope of those risks vary from project to project and are tied directly to the context (the environment in which the project will be built such as geography, local regulations, etc.) and content (physical elements of the project such as scope, budget, materials, etc.) of the project [25]. Risk in construction cannot be eliminated but can be managed once taken. It can be controlled, minimized, transferred or shared. In these conditions the management of risk has become a key element for the completion of the project within time scheduled and planned budget, and has been frequently examined from 1987 till today.

Construction requires the application of different types of resources to see a completed facility such as a multi-story building, an industrial project, or even a small room. These resources might include basic construction materials, manpower, equipment and technology, time and money. Each of these resources has some risks associated with it. Given the complexity, size, long time frame of concession contracts, and the multitude of stakeholders involved, the delivery methods of PPP projects have been judged to be full of risks [26]. From the viewpoint of public procurer there is an obvious need to ensure that value-for-money is achieved, while to the project sponsors is interested on direct revenues to cover the operating and capital costs and service debt provided by banks and other financiers [2]. These resources, along with associated risks, should be identified and managed to minimize losses and increase profits.

Despite the great importance of this issue, the knowledge on risk factors, especially from the internal stakeholders who deal with day to day operation, is very week. This situation is typical for developing countries, which have a short experience in PPP application and a lack of knowledge, experience and expertise on risk management process [27].

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In these conditions, the identification, classification, and the presentation of a wide list of possible risks developed from an extensive literature review gains a special importance to provide practioners in Albania and other developing countries with a useful tool during the PPPs implementation.

A heavy literature review on the specific topic was performed to develop a risk mapping matrix. A list of risks affecting PPP projects was generated based on the review of: [2], [6], [28]-[56] (Table VI).

VI. Discussions on Significant Risk Factors

Risk management is one of the key success factors of construction projects. PPPs, being considered as huge investments with long term schedule, need particular attention and effective management to avoid failures. Thus, the main objective of this section is to discuss on the identification, rating and prioritization of these risks.

The literature provides a list of possible risks influencing the overall success of a PPP project. The wide range of risks was categorized in eleven groups, such as:

1. Political Risks: due to unsupportive governments
2. Construction Risks: due to problematic construction techniques, cost escalation, schedule delays, etc.
3. Legal Risks: due to legal changes
4. Economic Risks: due to fluctuation of interest rate and inflation rate, etc.
5. Operating Risks: due to higher operating costs and maintenance cost
6. Market Risks: due to fluctuation of material cost by any parties, change in market demand, etc.
7. Project Selection Risks: due to uncompetitive bidding, competition risk, public opposition, etc.
8. Relation Risks: due to lack of organization and coordination
9. Project Finance: due to inadequate revenue streams and financing costs
10. Natural Risks: involving adverse environmental conditions, and force major
11. Design Risks: due to design deficiency and scope variation.

The factors mentioned on each of the reviewed publications are mapped and the results are elaborated below:

Political Risks may occur due to several unsuspected situations related to government practices, political opposition, public decision making, expropriation, etc. The investigation resulted that risk related to 'Expropriation of assets', 'Corruption' and 'Strong political opposition' were the factors most often identified, respectively on 16 publications out of 31 reviewed (16/31), 15 publications out of 31 reviewed (15/31) and 12 publications out of 31 reviewed (12/31).

Construction Risks most often mapped were 'Non-Availability of appropriate material' (17/31), 'Non-Availability of appropriate labor' (16/31), and 'Construction time delay' (14/31), followed by other factors such as: 'Construction cost overrun' (11/31), 'Availability of finance during construction' (10/31), 'Land acquisition' (9/31), etc.

The main *Legal Risks* mentioned were related to the government regulations, including 'Legislation Change' (19/31), 'Change in tax regulations' (16/31), 'Imperfect law and supervision system' (9/31), followed by other scenarios such as 'Lack of legal framework', ' 'Improper contract/ contract variation' and various restrictions on import/export and rate of return.

In the category of *Economic Risks*, fluctuations of interest rate, inflation rate and foreign exchange rate are the most often mapped risk factors. These scenarios were emphasized especially in developing countries characterized by an immature local economic and banking system.

'Operation cost overruns' is the most significant risk factor in the *Operation Risks* category, due to lack of planned schedule or low efficiency during operation and maintenance. These situations may also lead to 'Project /operation change' (7/31), 'High maintenance cost' (7/31), 'Low operating productivity' (5/31), 'Residual Value after concession' (5/31), etc.

Market Risks: Fluctuation of market demand or market price may generate risky situations characterized most often by 'Tariff change' risk factor. These risks occur when dealing with improper design of lack of flexible framework.

In the category of *Project Selection Risks,* 'Public opposition', 'Change in the level of demand for the project', and 'Site availability' are the most often mapped factors, respectively identified on 11 publications out of 31 (11/31), on 11 publications out of 31 (11/31), and on 10 publications out of 31 (11/31).

'Lack of organization and coordination' and 'Inadequate experience on PPP agreements' are the two most significant factors on the category of *Relationship Risks,* followed by 'Different working methods between parties' and 'Inadequate distribution of responsibilities'.

Project Finance Risks may happen due to 'Unavailability of financial attraction of projects to investors' (8/31), followed by other factors such as 'High finance cost' (5/31), Lack of creditworthy', 'High bidding cost', etc.

Natural Risks mapped more often resulted to be 'Force Majeure (17/31) and 'Environment' (17/31), followed by 'Weather conditions, and 'Unforeseen geotechnical conditions' mapped on 10 publications out of 31 reviewed.

Design Risks are most often related to delays in project approvals and permits as well as residual risks.

VII. Conclusions

Public Private Partnerships have been developed and introduced as a new way of project delivery by involving collaboration between public sector and private sector. The general principle of these agreements is based on risk sharing optimally between parties, offering a win-win solution in terms of achieving the value for money by the public part and the expected rate of return by the private one. In order for a project to be successful, managing risks and maximizing opportunities is of main importance. In the framework of an iterative management, identification of the key factors to direct the managerial attention is an important task.

An investigation carried out by reviewing 31 related

publications has been outlined in this paper. The mapped risk factors were clustered in eleven categories named Political, Construction, Legal, Economic, Operating, Market, Project Selection, Relation, Project Finance, Natural, and Design Risks. The most important mapped risks resulted to be: 'Interest rate fluctuation' (Economic Risks), 'Legislation change' (Legal Risks), and 'Operation cost overrun' (Operation Risks). This investigation may be considered as a baseline in developing a further research regarding risks in PPP projects, with a special focus on risk allocation.

TABLE VI
RISK MAPPING MATRIX

	Risk Category	Risk factor	[28]	[6]	[29]	[30]	[31]	[32]	[33]	[34]	[35]	[36]	[37]	[38]	[39]	[40]	[2]	[41]	[42]	[43]	[44]	[45]	[46]	[47]	[48]	[49]	[50]	[51]	[52]	[53]	[54]	[55]	[56]	Frequency
1	Political	Change in law			*		*	*			*	*	*	*	*																			**8**
		Delay in project approvals and permits	*	*	*	*				*		*		*	*	*													*					**10**
		Expropriation of assets		*		*		*					*	*	*		*	*			*		*	*	*	*	*		*				*	**16**
		Poor public decision making process		*	*	*	*	*															*		*	*	*		*			*		**11**
		Inconsistences in government policies	*			*	*																											**3**
		Strong political opposition		*	*	*				*				*			*						*	*	*	*	*		*					**12**
		Unstable government		*		*					*											*	*	*	*	*								**8**
		Government intervention			*			*						*			*		*		*				*	*	*		*			*		**11**
		Lack of support from government																				*		*				*	*				*	**5**
		Corruption		*		*	*	*			*						*		*	*		*		*	*	*	*		*			*		**15**
		Termination of concession by government																													*			**1**
2	Construction	Land acquisition	*	*		*	*	*				*		*	*	*																		**9**
		Non-Availability of appropriate labor		*	*	*	*	*					*	*	*		*						*	*	*	*	*	*	*					**16**
		Non-Availability of appropriate material		*	*	*	*	*					*	*	*		*						*	*	*	*	*	*	*				*	**17**
		Availability of finance		*	*		*	*			*	*		*	*							*							*					**10**
		Construction cost overrun		*	*	*	*					*		*	*								*	*						*	*			**11**
		Design deficiency		*	*	*	*		*	*					*							*												**8**
		Construction time delay		*	*	*	*				*	*	*	*									*	*		*			*	*			*	**14**
		Excessive contractual risks		*	*	*	*	*		*	*																							**7**
		Sub-contractor failure																					*											**1**
		Late design changes		*	*	*								*	*																			**5**
		Contractor failure	*		*		*				*			*																				**5**
		Project delay	*		*			*		*																								**4**
		Completion risk						*						*	*																			**3**
		Consortium inability					*				*																							**2**
		Unproven engineering technique			*			*						*	*																			**4**
		Resettlement and rehabilitation										*			*																			**2**
		Quality risks												*	*																			**2**
		Default of subcontractors and suppliers		*		*																												**2**

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		Poor quality of labor		*		*																	*	*						*				**5**
		Change of scope			*							*						*																**3**
		Lack of supporting infrastructure			*																													**1**
		Site safety and security																				*												**1**
3	**Legal**	Change in tax regulations	*	*		*		*						*		*	*				*		*	*	*	*	*	*	*				*	**16**
		Excessive contract variation																					*	*										**2**
		Legislation change		*	*	*		*		*	*					*	*	*		*			*	*	*	*	*	*	*	*	*			**19**
		Industrial regulatory change		*		*									*								*											**4**
		Rate of returns restrictions				*																												**1**
		Imperfect law and supervision system			*									*			*	*		*					*	*			*				*	**9**
		Lack of legal framework			*																	*		*					*					**4**
		Improper contract																							*	*								**2**
		Lack of standard model for PPP agreements																													*			**1**
		Interest rate fluctuation	*	*		*	*	*				*		*			*				*	*	*	*	*	*	*	*	*		*	*	**20**
		Inflation rate fluctuation	*	*	*	*	*	*						*			*					*	*	*	*		*	*	*	*	*	*		**18**
4	**Economic**	Foreign exchange rate fluctuation			*	*	*	*					*	*			*	*			*	*			*	*	*		*			*		**15**
		Poor financial market		*		*				*																								**3**
		Influential economic events																													*			**1**
		Financial risks																						*	*	*	*	*	*	*		*		**8**
		Operation cost overrun		*	*	*	*	*				*		*		*		*					*	*	*	*	*		*	*	*	*	*	**19**
		Residual value (after concession period)		*		*		*						*	*																			**5**
		High maintenance cost		*		*	*								*								*	*							*			**7**
		Operation financial risks		*		*	*					*																						**4**
		Low operating productivity		*		*	*																*	*										**5**
		Risk regarding pricing of products/service			*	*		*																										**3**
5	**Operation**	Operator default												*	*																*			**3**
		Quality of operation												*	*																			**2**
		Project/Operation change						*		*													*			*	*		*			*		**7**
		Technological risk					*																		*	*								**3**
		Waste of material												*																				**1**
		Operational revenues below expectations																					*											**1**
		Maintenance more frequent than expected																					*	*										**2**

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6	**Market**	Tariff change	*								*		*	*	*		*	*							*	*					*			**10**
		Change in market demand						*	*					*	*		*	*			*	*												**8**
		Fluctuation of material cost by public part												*	*																				**2**
		Fluctuation of material cost by private												*	*																				**2**
		Market competition																		*		*													**2**
7	**Project selection**	Public opposition to project		*		*	*	*						*				*				*	*	*					*				*	**11**
		Uncompetitive tender						*		*	*	*													*	*	*		*						**8**
		Change on the Level of demand for the project		*		*	*																*	*	*	*	*		*		*	*		**11**
		Competition risk				*																			*	*		*							**4**
		Site availability																					*	*	*	*	*	*	*	*	*		*	**10**
8	**Relationship**	Different working methods between partners		*	*	*				*	*						*						*	*										**8**
		Inadequate experience in PPP		*	*	*	*				*						*	*					*	*	*	*	*		*					**13**
		Lack of commitment from public/private part		*		*					*						*						*	*										**6**
		Organization and coordination risk		*	*	*		*						*			*	*					*	*	*	*	*		*		*			**14**
		Third party liability		*		*		*															*		*	*									**6**
		Inadequate distribution of risks and responsibility		*		*					*			*			*	*					*	*										**8**
		Inadequate negotiation period			*	*																													**2**
		Staff crises		*		*																	*												**3**
		Cultural differences between main stakeholders				*																													**1**
		Noninvolvement of host community				*																													**1**
		Conflicting or imperfect contract			*																														**1**
		Private Investor Change																							*	*									**2**
		Subjective evaluation																							*	*						*			**3**
9	**Project finance**	Financial attraction of project to investors		*	*	*	*				*					*							*	*											**8**
		High finance cost		*		*					*												*	*											**5**
		Lack of creditworthiness				*		*			*																								**3**
		High bidding cost				*					*																								**2**
		Delay in financial closure									*	*																							**2**
		Inability to service debt				*																													**1**
		Lack of government guarantees				*																													**1**
		Delay in										*																							**1**

	Risk Category	Risk factor	[28]	[6]	[29]	[30]	[31]	[32]	[33]	[34]	[35]	[36]	[37]	[38]	[39]	[40]	[2]	[41]	[42]	[43]	[44]	[45]	[46]	[47]	[48]	[49]	[50]	[51]	[52]	[53]	[54]	[55]	[56]	Frequency
		payments																																
		Financiers unwilling to take high risks									*																							**1**
		Force majeure	*	*		*	*	*				*		*			*	*					*	*	*	*		*	*		*		*	**17**
		Environment	*	*		*	*	*								*		*		*			*	*	*	*	*	*	*	*	*			**17**
10	**Natural**	Weather	*	*		*		*															*	*		*			*		*		*	**10**
		Unforeseen geotechnical conditions		*		*		*						*	*								*	*	*	*			*					**10**
		Residual risks															*						*	*	*	*	*	*	*	*				**9**
		Delay in project approvals and permits																					*	*	*	*	*	*	*	*		*		**9**
11	**Design**	Design deficiency																					*	*				*						**3**
		Unproven engineering techniques												*									*	*			*		*				*	**6**
		Scope variation			*													*						*					*					**4**

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