

# **Exploring Risk Priorities for Road Infrastructure Investment Projects by Public-Private Partnership (PPPs) using Psychometric Scaling: A Survey from Brazilian Experience**

**Aline Rodrigues**

*PROFIAP –Master’s Degree in Public Administration  
Universidade Federal Fluminense*

**Erinaldo Nascimento**

*PROFIAP –Master’s Degree in Public Administration  
Universidade Federal Fluminense*

**Pedro Pereira**

*PROFIAP –Master’s Degree in Public Administration  
Universidade Federal Fluminense*

**Selma Regina Martins Oliveira**

*PROFIAP –Master’s Degree in Public Administration  
Universidade Federal Fluminense*

## **Abstract**

The present research aims to prioritize risks in road transport infrastructure investment projects by Public Private Partnerships (PPPs) in Brazil using psychometric scaling. For that matter, it was initially sought to select and categorize, following the guidelines provided by specialized literature on the subject, the risks involved in those types of projects. Following that, a matrix of such risks was constructed and submitted to evaluation and approval by a specialist in risk management within those projects. Afterwards, the given results were e-mailed and sent via LinkedIn in the form of a questionnaire intended for professionals who work both in the private and public sections, people with experience in project management, concessions and Public-Private Partnerships. The data resulting from the questionnaire were then analyzed by means of the usage of the psychometric scaling method in order to capture the thoughts of specialists on the degree of impact made by each risk. The results achieved during the course of this work were satisfactory, given that it was possible both to achieve the intended goal and to provide an answer to the presented research-related problem. The risks to be prioritized in the follow-up of the projects were properly identified.

**Keywords:** Risks, Road infrastructure investment projects, Public-private partnership (PPP), Psychometric scaling, Brazilian experience

## 1. Introduction

The Public-Private Partnerships (PPPs) go back, historically, to the time in which the State began to be questioned regarding its role as an exclusive provider in what refers to providing public services. Such questioning was ignited by financial and tax-related crises, aside from the principles of the Washington Consensus, which demanded a significant alteration in State action. Those questionings and claims have caused changes in the State's posture regarding economical actions, and the establishment of a liberal agenda (Franco & Pamplona, 2008).

During the 1990s, due to tax and financial crises, within a scenery of deterioration of the infrastructure and of public services, the Private Finance Initiatives (PFIs) arise in the United Kingdom as a means to induce the private participation in areas in which the market alone was not capable of spontaneously guaranteeing private investment. In Brazil, the provision of infrastructure was affected by that tendency, triggering a process of privatizations e concessions of public services (Franco, 2007). Such process was intensified even more with the improvement of the legal and regulating apparatus which consolidated the PPPs as public policies of investment, development and service rendering by the State.

From then on, the PPPs' model has been implemented in sizable national infrastructure projects, such as the construction, maintenance and operation of subway stations, airports and highways (Davies, 2006). The latter will be the subject of study in this research. Projects deriving from PPPs, like the ones mentioned above, due to their peculiarities concerning time, costs and planning, are considered extremely complex and subjects to an infinity of risks, which need to be managed in an efficient manner as to assess, mitigate and distribute those risks among the involved parties (Oliveira and Cazarini, 2011). Such risks are linked to the high level of uncertainties pertaining to the whole life cycle of a PPP project, as well as the variety in nature of the issues to be addressed accordingly to their progress as well as the formats and the influence of the given conditions for their development (Yogui and Moreno, 2014).

An adequate allocation of risks among the partners is considered to be the primary source of PPPs' efficiency, being it necessary to observe the basic principle that the risks must be allocated to the one who best knows how to handle them at the lowest price (Irwin, 2007). Errors in the identification and evaluation process of the risks, like the non-observance of the allocation and risks principles, may well affect the gains obtained by project's expected effectiveness (Franco, 2007). The present research aims to prioritize risks in road transport infrastructure investment projects by Public Private Partnerships (PPPs) in Brazil using psychometric scaling, from the standpoint of different specialists. This article is structured as follows: section 2 - literature review; section 3 – methodology; section 4 – results and discussion; and section 5 – conclusion.

## 2. Literature Review

In a study gathered from the World Economic Forum, in which 137 countries were evaluated, the quality of the transportation infrastructure in Brazil ranked in 65<sup>th</sup>, whilst its roads' quality in 103<sup>rd</sup> (World Economic Forum 2017-2018). Given such data, the need of investments, especially in infrastructure of highways, becomes evident, as they encompass the main means of Brazilian transportation since the first half of the twentieth century, both for passengers and cargo, which makes it desirable that the private sector takes active participation on the matter, both in gesture and in financing, provided by concessions and PPPs (CNT, 2018; MTPA, 2018).

During the 1990s, the Brazilian Federal Government started the Program of Concessions of Federal Highways, leaving it up to private initiative to complete the projects regarding roads' infrastructures (MTPA, 2018). The PPPs were inserted in the Brazilian judicial order in 2004, which amplified the possibility of structuring the partnerships between the private and the public sectors, seeking to render public services (Pasin, 2012). That new model of cooperation is more complex than the traditional concessions, as it needs more detailed contracts due to its greater risks, and, furthermore,

to the proper provision of high quality services to the government at lower costs than exclusively public provisions would require (Aragão *et al*, 2007).

In Brazil, the common concessions are characterized as being renderings of public services by the private sector, in lieu of the Public Administration, which allocates the risks to the concessionary, and whose wages come mainly from the fees that users pay or from other means of compensations stemming from service exploitation – that is, as long as payments made in cash are not made by the Public Administration (Borges and Neves, 2005). There are no minimum deadline requirements or a limit for the duration of the concession, nor the stipulation of investment values. However, some experiences have come to show that the common concession model demonstrated limitations in certain sectors of public utility, such as prisons, schools, roads etc. For that reason, one sought alternatives for the revival of investments in new projects, and, in that context, the PPPs came as an option on the matter of enabling infrastructure projects and the provision of public services (Franco & Pamplona, 2008).

One of the main characteristics of the concessions made by PPPs is its leaning towards the rendering of services for which the State is responsible, with the possibility of a financial compensation from the government (Brandão and Saraiva, 2007; Borges and Neves, 2005; Gregg, 2006). There is also the possibility to use PPPs in already existing concession projects, which enable the liberation of otherwise compromised resources. Hence, that is not a prevailing tendency among the involved public entities, which aim to prioritize the PPPs for new and urgent work (Borges and Neves, 2005).

The active parties and the services traditionally provided by the public sector are now being provided through a new contractual arrangement between the government and the private sector (Gregg, 2006). The PPPs build up the relationships between the public and private partners in a way which generates aggregated value by means of risks allocation, transferring them to the more suitable managing part (Aragão *et al*, 2007). Moreover, the concessions made by the PPPs are divided in two categories: the administrative one and the sponsored one (Borges and Neves, 2005). The administrative concessions are meant to a provision of services in which the Public Administration is the direct or indirect beneficiary, even if the process involves construction work or the supply and installation of assets. The sponsored category consists of the concession of public services or construction works when they involve, additionally to the charged fees of the beneficiaries, financial compensation from the public to the private partner (Miyabukuro, 2011).

The PPPs are also contemplated as complex contractual arrangements in a long term between the private and the public sectors, in which the government commits to future duties through financial contributions whilst the private sector must provide commodities and infrastructure-related public services (Brandão and Saraiva, 2007; Franco & Pamplona, 2008; Lewis, 2001; Väilä, 2005; Davies, 2006; Borges e Neves, 2005). Such relationship should generate a balance between the parties, which is reached through several steps of negotiation (Aragão *et al*, 2007). Those arrangements must undergo three stages: planning, bidding and managing of the contracts (Bing *et al*, 2005).

The planning and managing of contracts by a PPPs are rigidly controlled and go through risks management. Risks are unfavorable, unforeseeable or hardly foreseeable events which can cause increases in the contractual charges, thus affecting the rentability and the efficiency of the concession contracts (Graeff and Martins, 2011). The risks, furthermore, consist of conditions in which the calculations of the probability of a given occurrence are susceptible to being wrong (Lupton, 2009; PMBOK, 2008). The risks management undergoes the following stages: identification, evaluation, allocation, mitigation, monitoring and revision (Partnerships Victoria, 2001). Apart from that, it involves making decisions in an uncertain, complex and dynamic environment (Salles *et al*, 2006). Those risks have been proved to being critical factors of success in a PPPs projects (Bing *et al*, 2005). For that reason, as stated before, they must be distributed accordingly to be administration capacity by the agents involved in the partnerships.

Regarding the construction of PPPs projects, the efficiency in risks management is one of the main elements in the equation. Such risks must be properly managed so that the projects are successful (Bertozzi, 2015). Besides, it is crucial to count with the presence of the government as a risk mitigating

agent, as variables like interests' rate, regulations and variations in the market, which affect the key parts of the projects, should be under its control (Brandão; Saraiva, 2007). The PPPs allow a great risk allocation among the private and public sectors (Gregg, 2006). That way, the risks regarding construction and operation of the projects are then transferred to the private sector, which increases efficiency. Plus, the public sector enables the private party to make investments, thus sharing the risks involving demands (Franco & Pamplona, 2008; Väililä, 2005; Aragão *et al*, 2007). Within the category of PPPs' contracts, the share of the risks between the public and private partners is one of the most vital issues for the analysis of the financial viability of a project, both concerning the private and the public parties. Also, the risks matrix must be elaborated during the study of such viability (Bertozzi, 2015).

The study mentioned above is made during the phase of project planning. Much like in all the management processes, it is imperative that one elaborates a plan in advance. That does not differ from the formulation of a project and the previews regarding its uncertainties and risks. Accordingly to that, Grilo (2008) understands that the planning and the effective management of the projects are the main mitigating actions for the risks concerning its process. It is, thus, imperative to distribute de risks accordingly to the aptitude o each agent to bear and handle them (Miyakabukuro, 2011; Bing *et al*, 2005; Brito; Silveira, 2014). Such aptitude translates as the acceptance of risk with as low a cost as possible. All of it aims to achieve maximum efficacy, which, in PPPs contracts, is potentialized by the possibility of integrating the projects' elaboration and construction and their infrastructure operation within a single agent's competence (Brito; Silveira, 2014). There is a primary legal guideline regarding efficiency in the Brazilian PPPs-related laws in which concerns the accomplishment of the work by the state and the proper allocation of society's resources.

The efficacy must show in a better service quality, which the PPPs projects promise to provide, thus proving to be even more important when the context in which the PPPs are formed lies within fiscal constrictions. That reinforces the need of a good project management. However, if the PPPs are poorly based and conducted, they just might accentuate fiscal crises (Brito; Silveira, 2014). Also, the occurrence of unexpected events may end up increasing the costs of the contract (Neves, 1995). It is necessary, for that matter, that one makes an analysis of the environment in order to identify possible uncertainties underlying the project, and, by doing so, identify opportunities and menaces that might affect (either in a positive or negative way) the execution of that project as well (Valeriano, 1998).

The high capacities of innovating and well managing its assets possessed by the private sector results in the increase of the productive efficacy regarding the project, and, in consequence, the improvement of quality and reduction of costs of the rendered services. That gain in efficacy, especially in developing countries, must be considered of great importance, since the fiscal crises and the need of new investors make it so that the government encourages the involvement of the private sector in infrastructure projects (Gregg, 2006). Given the complexity of the PPP contracts, the matrix of risks must be built in the study of viability of those projects in the field of thoroughfares, in order to meet society's expectations, which hopes for a substantial improvement regarding the traffic of the highway transportation system (Cherobin, 1999).

In Brazil, it is imperative to have investments in transportation-related infrastructure projects, considering that they are crucial for the organization and the dynamics of the State, besides being essential to the flux of travelling people, inputs and final products. A good transportation infrastructure translates a nation's potential to develop its social and economic affairs. Data taken by the Ministry concerning infrastructure show that the federal paved highway network covers an area of 65.369,6 kilometers in total, whereas the unpaved one encompasses 10.374,5 kilometers (MTPA, 2018). Traditionally, our country has been dependent of that kind of modal in order to properly dispose of its production, and, therefore, the investment in a quality management of those highways proves to be strategic. With the purpose of increasing constructions' efficacy, maintenance and operation of those highways, the government has put into practice the process of concession of their infrastructure. This way, the present research aims to prioritize risks in road transport infrastructure investment projects by PPPs in Brazil using psychometric scaling.

### 3. Methodology

In the matter of risks allocation there can be used three typical methods: a straightforward list of risk factor, a risk matrix and a risk allocation structure (Bing *et al*, 2005). From the standpoint of projects' management, the risk is characterized by its probability of occurrence e by its impacts upon the project's goals (PMBOK, 2013). However, this research has only taken into account the latter. The present research proposed the adoption of a risk matrix and, through its usage, aimed to investigate what risks must be prioritized regarding investments in infrastructure projects which encompass the highway transportation financed by Brazilian PPPs. For that matter, at first, it recurred to the exploratory research of the theme's related literature pieces. Articles taken from periodics, both national and international, that are related to the PPPs and the infrastructure projects were selected from the Periódicos Capes platform, as well as the Science Direct and the Emerald. Furthermore, a documental analysis of the Laws of Concessions and Public-Private Partnerships, as well as Brazilian governmental reports, was thoroughly made.

From the selected Works and data on the subject, the next step was the qualitative/quantitative approach. The authors chose and categorized the risks deemed applicable to investments in infrastructure projects related to road transportation made by PPPs. Then, they built a matrix for the purpose of scaled assessments. Such matrix of risks was submitted to the evaluation and validation by a specialist in risk management projects, and, later one, sent to professionals in the area, both in the private and public sectors, in the form of a questionnaire via e-mail and LinkedIn. The professionals were picked on the grounds of their experience in infrastructure projects management, concessions and Public-Private Partnerships.

The questionnaire aimed to get a better perspective over what risks should be prioritized in the infrastructure projects, accordingly to the specialists. In order to achieve that, the scaling method of psychometric evaluation, which consists of understanding the different professional perspectives on each given risk. They were then evaluated, following the expertise of the specialists, on their impact degree over the infrastructure projects, in a scale of 0 to 5, where 0 zero represents no risk of impact and 5 the biggest possible risk.

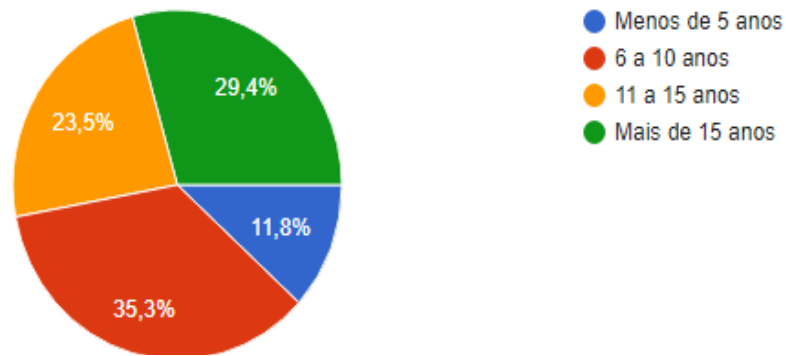
Regarding the questionnaires, sent to a total of 154 professionals, 17 of them were answered, which configure a response rate of 11,03%. 41,17% of the respondents, represented of them came from the public sector, whereas the remaining 58,83% work on the private sector. 52,9% of the participants handle projects managements, and the other 47,1% work with PPPs management. Aside from the risks' evaluation, the questionnaires requested personal information on their respondents, so as to attribute proper value to the provided answers. They were asked in which sector they work (public or private), the name of the institution which they worked for (either a company or a public organ), their specific fields of operation (as consultants, professors, specialized attorneys, public gestors etc.) and the position they occupied.

## 4. Research Results and Underlying Conclusions

### 4.1. The Respondents' Profiles

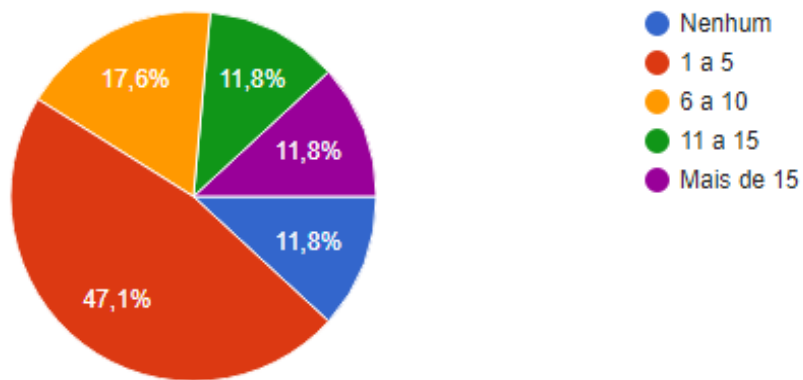
The questions were answered by specialists in projects management who have had experience with PPPs, both in the private and in the public sector. 10 of them are from the private sector (58,8%) and 8 from the public one (41,2%). Regarding the experience of the respondents, it was shown that 88,2% of them had worked for at least 6 years in their fields, and 29,4% of them all had been in their areas of interest for more than 15 years.

**Figure 1:** Years of experience in the area-respondents



The second image shows us that, out of the 17 respondents, 15 of them (88,2%) have already participated directly in at least one project involving a Public-Private Partnership. 41,2% have participated in more than 15 PPPs projects.

**Figure 2:** Participation in PPPs projects



The risks were classified in 9 categories, as stated in Appendix 1, and evaluated accordingly the specialists’ opinions, on a scale of 0 to 5, being 0 the representative of no impact, 1 or 2 of little impact, 3 of moderated impact and 4 or 5 of high impact.

**4.2. Risks’ Evaluation**

As stated before, the questionnaire sent to the specialists in Public-Private Partnerships aimed to get to know the risks that should be prioritized in the construction and execution of a PPPs project. On Table 1, there’s an indication of the risks classified as of high impact by the ones who answered the questions, whose responses consisted, predominantly, of a punctuation above 4.

**Table 1:** Primary Risks – Summation of the points gathered from the questionnaires’ answers

<u>Risk</u>	<u>Points</u>
Corruption	75
Lack of commitment between the parties involved	67
Change of government and/or policies	67
Approval of projects and licenses	67
Alteration in fees	65
Inadequate distribution of responsibilities	65

<sup>1</sup> Respective translation: blue – none [projects]; red - 1 to 5; orange – 6 to 10; green – 11 to 15; purple – more than 15.

<b>Risk</b>	<b>Points</b>
Demands	64
Environmental factors	62
Time factor	62
Attraction of new investors	62
Contractual risks	61

Source: table elaborated from the authors

Below, the authors will analyze the impact of each risk based on the obtained answers, organizing them per category in the matrix.

#### **4.2.1 Category: Natural Factors**

Amongst the natural factors, the unforeseeable cases are considered by the specialists to be a risk of moderate impact. To 41,1% (7) of the respondents, they scored from 0 to 2 points on the priorities' scale. The rest of the respondents (10 in total) attributed to those from 3 to 5 points, having 23,5% scored a 3 to such risks, which is why they are considered of moderate impact. The environmental-related risks present a high impact according to the specialists' evaluation, as 58,8% (10) of the respondents attributed from 4 to 5 points to them. That type of risk, as shown in the results of the research, is the 8<sup>th</sup> of highest impact on a Public-Private Partnership. For the mitigation of environmental impacts resulting from the projects, preventive measures such as reforestation, recuperation of watersheds in areas under influence of the projects, environmental sanitation and water treatment are cited. Moreover, the benefits derived from such mitigating actions must be evaluated and deducted from the resulting liability of the projects. That is called the environmental net liability (Grilo, 2011).

#### **4.2.2 Category: Relationships**

The risks presented in that category are, generally, highly important to the specialists. The inadequate distribution of responsibilities among the members of the projects scored from 4 to 5 points from a majority of 58,8% (10) respondents, which entails high impact. In the methodical work-related and know-how differences between the partners, the score of 3 points was given by the majority: 8 respondents (or 47,1%). Therefore, that risk is classified and one of moderate impact.

In the event of wrongful distribution of authority among the partners, the provided answers showed diverse ways of thinking about the gravity of the matter. The conclusion led to its classification as a risk of moderate to high impact. That happened due to the fact that 52,9% (9) of the respondents scored 4 or 5 to such risks, whilst 17,6% (3) attributed to them only a 3.

Regulatory problems might cause lack of clarity regarding the duties of ministries, executive offices, bidding bodies and regulatory agencies, which may encourage populist influences (Grilo, 2011). At last, the lack of commitment between the parties involved in the projects shows the vital importance of the relationship-related risks to them. Out of all the respondents, 47,1% (8) attributed a score of 5 to that type of risk. Also, 17,6% (3) gave it a 4, which totals 64,7% of scores above 4 and consolidates its high level of impact. Those risks, furthermore, come in 2<sup>nd</sup> place in the matrix, hence being the second highest impacting events over the projects. They can be, however, minimized through guarantees and creation of funds aimed to pay PPP projects, for instance (Franco and Pamplona, 2007).

Still regarding the risks of lack of commitment, one must observe that, in some cases, the governments extend the need of increases in fees, thus behaving in an opportunistic manner, for they promise to increase the fees e deny it later, after the project is done. A good example is the case in which the government of Pernambuco decided to unilaterally cut off the fees over the construction of a tolled highway before the elections. Another case happened when the Peruvian government reduced the concessions deadline from 30 to 15 years during the formalizations of contracts (Grilo, 2011).

#### **4.2.3 Category: Political**

Much like the relationship-related risks, the political ones take on a major role in the PPPs' projects, accordingly to the specialists' answers.

The risk of corruption was considered that of highest impact in the whole research. There is a total of 58,8% respondents who have attributed to it 5 points, while 29,5% gave it a 4. That sums up to include 88,3% of statements that such a risk is one of high impact. Corruption might occur in the phase of selection of the private partner or in the bidding phase, due to opportunistic, corruptive behavior and arbitrary selections made via the use of wrongful criteria. In order to avoid such occurrences, the team in charge of the project must prepare a policy which goes to prevent corruption by usage of a plan that should contain, essentially: a) procedures aimed to the dealing with conflicts interests; b) a code of conduct; c) a structured approach of supervision on the activities performed by third parties; d) a plan for the realization of audits, both internal and external (Grilo, 2011). In that sense, a change of government and/or of public policies was regarded as a high impact risk over a PPPs project. Out of all the given responses, 64,5% of them scored that type of risk a 4 or a 5, and another 23,5% of them scored it a 3, which goes to show the tendency of the management risks to be of great importance for a project. So as the PPPs programs succeed in Brazil, it is necessary to reduce the discretionary power of the government in order to isolate the projects and the agencies which regulate the political cycles and short-term outer pressures (Grilo, 2011).

The approval of projects and licenses also attains importance for the specialists in projects' management. 70,5% of the answers providing a score equal or higher than 4, 52,9% of them were of 5 points. Hence, the approval of projects and licenses has a high impact upon the management of a PPPs. Opposing the tendency of the other political risks, the nationalization and/or expropriation of active parties within the companies shows itself as a risk of low or moderate impact. 70,5% of the answers attributed the maximum of 3 points to that kind of risk, having 23,5% of specialists scored it 1 point. In the prince factor risk, its impact value appears as moderate of high, due to the more or less equal distribution of votes among the scores. 40% of them were a 4 or a 5, and 23,5% a 3.

#### **4.2.4 Category: Legal**

4 legal risks were presented in the questionnaire: the risk of alteration in the law was considered to be low or moderate, having it scored 3 points or less in 64,4% of the responses. Regarding the risk of the concessionary's bankruptcy, it was also considered to be low or moderate, with 58,8% of the scores within 2 or 3 points. As for the regulatory structure, considered for the risk of alteration over the rules imposed by the sectorial regulatory agency, the level of impact pointed out by the specialists was that of moderate or high, being 52,9% of the scoring within 4 or 5 points, and 70% of 3 points or more.

Regulatory problems may cause a lack of compensatory mechanisms facing unilaterally made fee adjustments. The private participation occurred many times without reforms or with incomplete regulatory marks, thus making it better to include reforms that seek separation between the roles of politics' formulation, regulation and provision of services. A strong regulator inhibits the political opportunism e reduces the renegotiations. Such renegotiations are onerous – increase the costs -, besides introducing uncertainties to the equation and reducing transparency (Grilo, 2011).

The last legal risks are the contractual ones. They involve the occurrence of contractual incompleteness due to the lack of capacity by the contractors of defining all the possible contingencies. The importance of that type of risk is held similar to the ones regarding lack of commitments between the parties involved. 58,8% scored it 4 or 5 points, and 76,4% 3 or more points. The payment made by the private sector may be conditioned to the performance given in the service rendering. The PPPs create long-term contractual obligations e must be monitors in a way which makes it possible to protect the public interest regarding the provision of high-quality services (Grilo, 2011).



#### **4.2.5 Category: Market-Related**

For the majority of the specialists (12 of them), the risk of insufficient demand has a high impact over the project's performance (70,6%). Those risks may occur due to situations such as projection errors and a macroeconomic environment. Aiming to reduce the probability of such occurrences, projections must be based on reliable grounds, contractual clauses which anticipate the repartition of losses for the demand reduction due to the performance in a given economic scenario (Graeff, 2011). The risk of alterations in fees was evaluated as one of high impact, with 12 responses (70,6%) deeming it 4 or 5 points. In order to control that risk, it is mandatory that the contracts contain clauses regarding the preview of periodical revisions of the fees, so as to maintain the economic-financial balance (Graeff, 2011).

The risk of competition was judged in various ways: 7 specialists (40,7%) deemed it as being of low impact on projects, 3 (17,6%) as moderate and 7 (41,1%) as high. Despite the divergences, those risks must also be regarded. They may occur due to a deviation of funds to competitors like airways and railways, inducing heavy competition in a given branch. Mechanisms aiming to increase the competitiveness must be created so to avoid those deviations e to seek balance between companies that are already competing within the same main field. They must also postulate measures to rebalance the direct interferences of the conceding Power (Graeff, 2011). The demographic risks, considering the possibility of changes in the population's characteristics that might affect the demand for the product were evaluated by 13 specialists (76,4%) as being of low impact.

#### **4.2.6 Category: Economic-Financial**

The risk of inflation was evaluated by 64,7% of the respondents as of moderate or low impact. The inflationary effect might impact the financial return of the investment, thus, in the analysis of the financial flux projects, it is recommended the stipulation of prices accordingly to current market values, that is, nominal prices from year to year instead of constant ones (Grilo, 2011). In that same scope, alterations in rates of interests were deemed by most of the respondents (12 of them, or 70,6%) as causing moderate to low impact. The exchange-related risk, which might be translated as the risk that the fluctuation in the exchange rates affects the investors when they convert values, received in the local currency, into foreign currencies, plus the cost of financing in those foreign currencies, was evaluated as posing moderate threat to the projects (41,2% of the respondents deemed it moderate, 29,4% low and 29,4% high in impact).

The investors tend to favor projects financed in local currency in order to mitigate the exchange-related risks (Grilo, 2011). The factor of financing availability, which corresponds to the risk of the private agent not obtaining the expected financing for the execution of the contract, was evaluated by most specialists (58,82%) as being of high impact. That risk may compromise the project due to the lack of resources required for its development, and in order to mitigate it, it is imperative to require all that all the propositions include guarantees regarding the financial commitments with minimal and easily maintained work conditions (Graeff, 2011).

The costs of financing, which represent the risk that the prices and financial conditions of the private agents differ from what as initially planned was deemed by 82,4% of the specialists as being of moderate to high impact. The allocation of risks greatly affects the capital costs and the feel levels (Grilo, 2011). The factor of attraction of new investors, which corresponds to the risk of the private agent not getting the expected resources through external investors was evaluated by 58,8% of the respondents as posing high threat. That way, it is essential to plan and clearly inform the investors about the advantages of investing in that particular project, by demonstrating the payouts to be collected in long-term. In the 1990s, many companies took participation in the private infrastructure market, even with poorly structured operations. However, in the current context, in order to attract the investors, the new projects must demand bigger cashier flows, as well as the mitigation of political and regulatory risks (Grilo, 2011).

#### **4.2.7 Category: Project e Construction**

The design factor, equivalent to the risk of making a mistake when conceiving the project, was deemed by 58,8% of the specialists as of high impact. The mechanism of financial and economic redistribution would be a way to diminish such risks (Lima and Coelho, 2015). Being that also the evaluation made over the factor of variation on the scope linked to the risk of changes in the specifications of the service, due to alterations in technological resources or common practices in the sector, which alters the costs. Such factor was, moreover, evaluated as of being of high impact by 52,9% of the respondents. As for the risks related to the selected location for the construction of the assets, which is connected to the factor of available terrain, was considers of high impact by 40% of the respondents. The technical factor in which refers to the risk of usage of inadequate construction techniques or failures in engineering was evaluated as moderate by 41,2% of the specialists and also high by 41,2% of them.

#### **4.2.8 Category: Operational**

The factor of increase in operational costs was deemed as posing high threat by 41,2% of the respondents. The bankruptcy of the subcontracted parties factor, however, was considered of low menace by 41,1% of the respondents. Such factor refers to the risks related to the bankruptcy of subcontracted companies, of which the private agent depends in order to accomplish his contractual obligations. The factor regarding workforce and supplies was considered to be of moderate effect by 47,1% of the responding experts. It relies on availability risks e increase in the prices of the inputs, low quality materials and Laboral inefficiency. Along this research, the authors sought to evaluate the risk of workforce availability. However, based on specialized literature on the subject (Grilo, 2011), they observed that, aside from the matter of availability is the need for the government to create control mechanisms over the Laboral matter, as to establish that the consortium properly pays fair wages and meets the existing security-related plans, providing that, due to pressures put into the reduction on contract prices, the private agent might abuse his position. The factor of time, which corresponds to the risks of the projects not being concluded in time as stipulated by the contract, was deemed as being of high impact by 58,8% of the respondents. Operational failures, which consists of the risks of inadequacy of the rendered services, were deemed as of moderate impact by 35,3% of the specialists and of high impact by 35,2% of them.

The risk of maintenance was evaluated as being of low impact by 58,8% of the respondents. It implicates the risks of the maintenance costs being pricier than previously expected. 41,2% of the respondents deemed the risk of modernization as being of high impact. It is related to the risks that the conception or the quality of the construction are insufficient in the rendering of the service.

#### **4.2.9 Category: Specific Risks**

The risk of enactment of a higher power refers to the risks of unforeseeable human events. 47,1% of the responding experts classified it as posing low threat to the project. A valid mitigating measure for such perils would be the partition of the risks among the public and the private partners (Lima e Coelho, 2015). The residual risk is linked to the conditions of the assets by the end of the contract, when they are thereby returned to the government. 47,1% of the specialists deemed it as being of low impact. As for the risk of civil responsibility, it refers to the possibility of compensations due to accidents occurred during the construction of the project, and it was evaluated as being of low impact by 47,1% of those who answered the questionnaire.

## **5. Conclusions and Recommendations**

The present research aims to prioritize risks in road transport infrastructure investment projects by PPPs in Brazil using psychometric scaling, based on the experience of specialists in the field. The results obtained during the work were satisfactory, since it was both possible to achieve the established

goal and to address the main issue of the research, thus identifying the risks that are to be prioritized in the matter. For the most part, the risks mentioned here, having been analyzed either individually or collectively within their categories and the among the other categories, were shown to be of moderate or high impact over the projects, which begs the need for follow-ups and the use of mitigatory actions. The authors concluded that corruption is, individually, the largest menace, followed by the lack of commitment between the parties involved, the change of government and/or public policies and the approval of projects and licenses (Table 1). Collectively, the political risks are the most representative.

It was also assured that the focus of the professionals regarding the risk of corruption, which, if it occurs, will bring great losses to society and contradict the principle of the supremacy of the public interests. Although that was pointed out as the main risk, the specialized literature is still scarce in terms of providing indications of mitigating measures. Therefore, this shall serve as future reference for further studies on the subject.

The authors also identified that all the given risks are correlated, so as there are no isolated impacts within the categories in which they fit. For instance, as mentioned earlier on, the lack of regulations (regulatory risks) might cause fee alterations for lack of compensatory mechanisms, authority issues caused by lack of clarity within the attributions and, moreover, the causation of increase in capital costs due to renegotiations. Another example is given by the risk of lack of commitment, which may lead to the fee alterations. It was verified, as well, that the respondents were indeed qualified, considering their years of experience and quantity of executed Public-Private Partnerships projects in which they took part, knowing how to measure which risks are more menacing to the road infrastructure projects. The limitations found during the research rely on the short time in which it was developed (From November 3<sup>rd</sup> to November 13<sup>th</sup>, 2019), and in the low quantity of those who actually responded to the questionnaire (17 professionals out of 152). The project also stuck to the issue of the impacts caused by the listed risks, not taking into consideration the matter of allocation and probability of their occurrence. Despite its limitations, however, the results were significant, given the achievement of the main goal. Seeking to contribute to future researches, it is recommended that the number of consulted specialists is higher and that one makes use of accurate statistic methods in order to obtain more precise data regarding the preferences of such specialist in the projects. The authors suggest, furthermore, that the issue of allocation of risks between the public and private partners and the probability of risk occurrence are included in the ultimate analysis.

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## Appendix1

**Table 1 of risk factors regarding PPPs in terms of highway transportation infrastructure**

Category	Risk factors
Natural	Unforeseeable cases Environmental
Relationship-related	Inadequate distribution of responsibilities Differences in the work methods and ‘know-how’ among the partners Inadequate distribution of authority among the partners Lack of commitment of the parties involved
Political	Corruption Change of government and/or public policies Approval of projects and licenses Nationalization/expropriation The prince factor
Legal	Alteration in the law Dealership’s bankruptcy Regulatory structure Contractual risks
Market-related	Demand Alteration in fees Competition Demographics
Economic-financial	Inflation Interest rate Exchange Financing availability Financial costs Attraction of new investors

Project and construction	Design Time Variation in scope Terrain Technical issues Increase in costs Subcontracted bankruptcy Default Availability of workforce and working equipment
Operation	Additional costs Operational failures Maintenance Modernization
Specifics	Higher power Residuals Civil responsibility Default

Source: Adapted by L. Bing et al (2005) and EVANGELISTA (2009).