Multi-Model to Assess the Impact of Knowledge on High Complexity Spectrum Performance under Uncertainty and Unpredictability: Towards PPPs Projects

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Abstract

This work intends to contribute to the planning guidelines in the field of high complexity spectrum. Thus, it develops a multi-model proposal to assess the impact of knowledge on public private partnerships projects performance under uncertainty and unpredictability, that considers a sequence of systematic procedures in the following phases: Phase 1: Modeling the needs of information in PPP under uncertainty and unpredictability. Phase 2: Modeling for the determination of critical knowledge in PPP projects under Uncertainty and Unpredictability. This research treated Brazil's transportation infrastructure as the empirical targets. Several support instruments were used in the modeling elaboration in order to reduce subjectivity in the results: psychometric scales - Thurstone*'s* Law *of Comparative* Judgment *(LCJ), multi-criteria Compromise Programming, Electre III, and Promethee II; Artificial Neural Networks (ANN); Neurofuzzy Intelligence. The results produced are satisfactory, validating the proposed procedure for PPP.*

Keywords: Multi-Model; Assessment, Impact of Knowledge; Public private partnerships; Transportation Infrastructure

1. Introduction

The feasibility of investments on road transportation infrastructure is now one of the great challenges for the Federal Government, due to the budgetary restraints in opposition to the growing demand for services traditionally supported by the Government (Ruiz, 2009). For this aim, public-private partnerships (PPPs) considers this a priority tool for infrastructure investment by this same Government. The concept of public private partnerships has attracted worldwide attention and acquired a new resonance in the context of developing countries. PPP are increasingly heralded as an innovative policy tool for remedying the lack of dynamism in traditional public service delivery (Jamali and Olayan, 2004). Several factors help account for the increased interest and popularity of PPP.

The promise of efficiency savings and a reduced burden on strained public resources has certainly struck a positive chord in countries operating under tight budgets. The appeal of PPP can more generally be explained in terms of their expected benefits, including access to private finance for expanding services, clearer objectives, new ideas, flexibility, better planning, improved incentives for competitive tendering and greater value for money for public projects (Spackman, 2002; Nijkamp, Van der Burch, and Vidigni, 2002; Marrewijk et. al., 2008).

Notwithstanding, PPP projects are a complex chain of events and decisions, which can break down at any of the weakest link: projects may be lost due to unrealistic predictions or the absence of its real role in the schedule agenda, or other initiatives that somehow followed wrong ideas that had many missteps or detail errors. Nevertheless, the building-up and the management of PPP projects represent complex and risky proceedings (Jamali and Olayan, 2004; Baloh, Jha, and Awazu, 2008), being able to affect the flow of the decisions, frustrating stability expectations, It is necessary to bear in mind that the risks can happen from diverse origins and scenarios caused by environmental factors or by factors inherent to the projects themselves.

Characteristics of projects vary; their analyses should be differentiated as well. In addition, pertinent literature diverges as regards the conception of PPP. The good practice recommends the fulfillment of articulated sequence actions, which consist of the following phases: (i) planning necessities; (ii) institutionalization and formation of a projects' team and determination of the communication procedures; (iii) the consolidation objectives, results and performance goals of PPP; (iv) study of the costs, prescriptions, cash flow; (v) study of the social impacts; (vii) analysis, allocation and management of risks (preliminary evaluation), etc. It is necessary to reflect in the direction of PPP and recognize that PPP projects implementation will not be simple and that one of the main focal points is effective organization of resources to instruct personnel so as to target knowledge required to reach a given work performance level.

Megaprojects involve multiple knowledge, each of which will be characterised by their specific rationalities, such that talk, decisions and actions will not necessarily be aligned with each other (Marrewijk et. al., 2008). The focus of this contribution is on the definition of knowledge priorities for PPP projects management. The knowledge may represent a strategic tool, increasing the institutional capacity of the Entrepreneurs in their assignments of formulation, evaluation and execution of such projects (Fletcher, Yiannis, and Polychronakis, 2007; Hanisch et. al., 2009; _Kannabiran, 2009; Kayakutlu and Buyukozkan, 2010). The knowledge would work as a facilitator instrument of improvement, contributing for the quality of services and the enhancement of the agility to decide.

Monitoring the performance of PPP from a knowledge perspective requires that the appropriate monitoring procedures are in place and operational (Fletcher, Yiannis, and Polychronakis, 2007; Godsell, Birtwistle, and Hoek, 2010; Svensson, 2007). Generally, a keen eye must be kept on the knowledge household of PPP. Especially important is watching the external environment for new events that may have impacts on the way PPP deals with knowledge shown as "incoming" arrows that will influence on the performance of PPP projects. Often the projects become impracticable still in the act of planning, becoming unsustainable. One of the points deserving much attention is the occurrence of errors in the management of PPP, which many times results in non-fulfillment of the established goals.

With such contrasting scenarios, technical efficiency is a parameter for the developing capacity of innovative PPP, which translates into one of the most remarkable logical arguments to potentialize and encourage competitive advantage. Therefore it should be imposed that efficiency in PPP planning propitiates more efficient decisions, diminishing improvisation and improvement of the involved team (Zhou and Fink, 2003). Traditionally, there are planning phase "sins" when elaborated without methods support or adequate techniques prioritizing knowledge able understanding that is especially essential in the management of the PPP. In this spectrum, the efficiency perspective of the PPP management should be standardized in knowledge, hence enabling a correct planning of the decisions to be made. With regards to the knowledge of the PPP viability in Brazil, it still is in a disadvantageous situation when compared with international experience. The scarcity of material, technological and human subsidies make such relevant projects unsustainable, hence unviable.

This work intends to contribute to the planning guidelines in the field of high complexity spectrum. Thus, it develops a multi-model proposal to assess the impact of knowledge on Public Private Partnerships Projects performance under uncertainty and unpredictability, that considers a sequence of systematic procedures in the following phases: *Phase 1:* Modeling the needs of information in PPP under uncertainty and unpredictability. This phase is structured in two stages: *Stage 1:* identification of CSF; *Stage 2:* evaluation of critical success factors, and *Stage 3:* Prioritization of the information needs starting from the crossing of CSF and the Areas of Information in PPP. *Phase 2:* Modeling for the determination of the critical Stakeholders' knowledge in PPP under Uncertainty and Unpredictability.

This phase has been subdivided as follows: *Stage 1* - Identification and Acquisition of Knowledge in PPP ; *Stage 2* - Knowledge impact evaluation on PPP performance; *Stage 3* - Representation of knowledge in mental maps; and *Stage 4*:- Determination of the effective rate of knowledge priority on PPP performance. This research treated Brazil's transportation infrastructure as the empirical targets. Thus, this work is systematized in the following sections: 1 – Research Design, 2 – Modeling and Underlying Analysis, and lastly, the conclusions and implications. These different phases and stages are detailed here.

2. Research Design

This phase is structured in two stages: Stage 2.1) determination of the conceptual model and hypothesis; stage

2.2) determination of the sample and data collection.

2.1 Conceptual Model: Constructs and hypothesis

This section details the elements that comprise the conceptual model (Figure 1) and hypothesis used in the study.

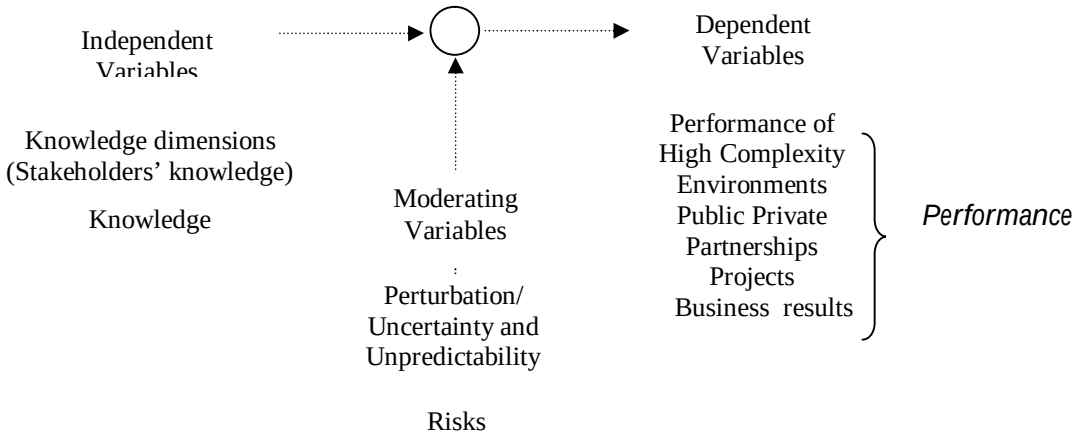

Figure 1: Conceptual Model

In the current competitive environment, knowledge is recognized as a fundamental asset for organizations (Teece, 1998). Management is increasingly aware that knowledge resources are essential to the development of their organizations (Carneiro, 2000). According to modern approaches, knowledge is already considered as a key factor in the organization's performance, because it deals with different resources that can aid decision makers in many ways (Keen, 1991). Thus, if management has a true strategic orientation, the knowledge development is a systematic, integrated, and planned approach to improve the effectiveness of intellectual capital of an enterprise (Edvinsson and Malone, 1998). It is designed to solve problems that adversely affect operating efficiency at all levels. Knowledge is one of the branches where development movements can occur to help managers in their decision making process, to create new responses, and to enable a set of competitive reactions and/or pro-active proposals.

The impact of knowledge on management decisions effectiveness should be considered to support and also provide insight into how knowledge workers can contribute to obtain better results. The organizations need to look for the knowledge that is able to add value. Value adding knowledge is very different to an information mix. This mix can be important, but first it is necessary to find out how the markets perceive the presence of value (Carneiro, 2000). Knowledge held by firms and individuals is a concept which is extremely difficult to measure through directly quantifiable indicators. An assessment of the relative importance of knowledge on organizations performance is relevant, because it informs both firms in their strategic decisions and governments in similar decisions regarding policies at local and national levels.

The building-up and the management of a PPP project require highly complex analytical approaches, which include subjective elements. Characteristics of projects vary; their analyses should be differentiated as well. In addition, pertinent literature diverges as regards the conception of PPP. The good practice recommends the fulfillment of articulated sequence actions, which consist of the following phases: Phase I comprises two steps: Step 1 – (i) planning for needs; (ii) institutionalization and configuration of project teams and determination of communication procedures (market testing, inclusive); (iii) consolidation of project objectives, results and performance goals; (iv) drafting of reference projects; (v) investigation of costs, budgets, cash flows;

(vi) study of social impacts; (vii) analysis, allocation and management of risks (preliminary evaluation); and (viii) analysis of basic viability. Step 2 – (i) project refinement; and (ii) refinement of analysis of costs, impacts and risks. Phase II encompasses the development and implementation, evolution and continuation. The characteristics of the PPP differ very much, becoming the object of analysis equally differentiated. Thus they demand the technical mastery of various technological, legal, financial and political aspects and procedures. Knowledge may represent a strategic tool, increasing the institutional capacity of both the Public Sector and the Entrepreneurs in their assignments of formulation, evaluation and execution of such projects (Fletcher, Yiannis, and Polychronakis, 2007; Godsell, Birtwistle, and Hoek, 2010; Mangan and Christopher, 2005; Svensson, 2007;).

These procedures will of course depend on the kind of measures taken earlier and must be tailored to them. But it is not only improvement plans that must be monitored. Generally, a keen eye must be kept on the knowledge household of PPP. Especially important is watching the external environment for new events that may have impacts on the way PPP deals with knowledge shown as "incoming" arrows that will influence the execution of knowledge (Miguel, Franklin, and Popadiuk, 2008; Schroeder, Pauleen, and Huff, 2009). Thus, the variables and hypothesis are:

Dependent variables*:*The independent variable was extracted from the specialized literature and assessed by experts for confirmation. The impact of knowledge on firm performance has been an enduring research theme in the literature (Sabherwal and Sabherwal, 2005). Tanriverdi (2005) has shown in the context of multi-business firms that intense knowledge activities have a direct impact on firm financial performance. Our aim is to shed light on the consequences of knowledge on firm organizations have. Knowledge has a considerable impact on corporate performance by producing an improved market position that conveys competitive advantage and superior performance (Walker, 2004).

Knowledge is one of the most important drivers for the organizations performance to the formation of an organizational learning climate and/or orientation with continuous efforts for improvements, renewals, exploration, and learning from failures and adaptation to rapidly changing competitive environment. In the light of the above discussions, we are now ready to propose that the knowledge has positive effect on organizations performance.

Independent Variables: The literature is replete with studies that suggest knowledge impact organizational performance. Bhatt (2001) stated that knowledge application means making knowledge more active and relevant for the firm in creating value. Droge et al. (2003) also argues that in the long run, firms that create new knowledge at a lower cost and more speedily that competitors, and then apply that knowledge effectively and efficiently, will be successful at creating competitive advantage. For knowledge to impact organizational performance it has to be used to support the firm's processes.

Hence, it is through knowledge utilization that acquired knowledge can be transformed from being a potential capability into a realized and dynamic capability that impacts organizational performance (Cohen and Levinthal, 1990; Seleim and Khalil, 2007; Zahra and George, 2002) (Mills and Smith, 2010). PPP may offer opportunities for exploiting the comparative advantages of both the private sector –knowledge […] (Jamali and Olayan, 2004). Effective government and stakeholder partnerships are gaining increasing importance for good public policy, including providing governments with cost effective avenues to expertise and knowledge, and facilitating greater public accountability.

A knowledge-based partnership learning capability and successful implementation of practices and techniques that enable mutual knowledge creation, dissemination, transfer, and application, is more than ever before becoming not only a critical success factor but also a differentiating competitive factor. (Riege and Lindsay, 2006).

Moderating Variables: Governments throughout the world are being forced to review how to fund the increasing demand and rising expectations of their citizens. This is especially relevant for developing countries, which often have limited capital resources to meet the soaring needs for essential infrastructure. This has consequently led to increased involvement of the private sector in the provision of public services, using various forms of Public-Private Partnerships (PPPs).

It is, however, important for both the public and private sectors to understand the various risks associated with PPP: demand risks; operating risks; design and construction risks; risks of use of land; institutional and legal risks; financial risks; specific risks; and environmental risks In an environment of unpredictability and unexpected change these variations or disturbances can make the results highly subjective. The following hypothesis was formulated using the conceptual model: *H:* The effective rate of knowledge priority on PPP projects performance is positive and depends of the interaction of the knowledge.

2.2 Sample and Data Collection

This work intends to contribute to the planning guidelines in the field of high complexity environments. Thus, it develops a multi-model proposal to assess the knowledge impact knowledge on public private partnerships performance on road transportation infrastructure. The researcher selected the more well-known road Concessions in Brazil. Thus, an integrated and chain model proposal was designed, based on the literature and confirmed by the assessment of experts. Following the logic underlying in the guidelines of the model, the data collection is permanently and periodically applied to the specialists, hence permeating all intermediate phases and steps addressed to the legitimacy and strength of the proposal.

In this classification framework, the research interviews and consultations with the experts are highlighted. With this procedure, the information collected can be set apart in different parts by adjusting the phases and steps of the model. In the data set collected it was necessary to apply a removal cleaning procedure called filtering, to first eliminate inconsistent and incomplete data, and secondly, to discard data that are irrelevant to the model. This enabled a better analysis of the variables involved, and also to obtain improvement in the quality of the data provided to the model. Data collection was conducted in two blocks. The first was to collect data to feed the development of the proposed model, extracting construct and content data from the specialized literature.

This proposal was confirmed by a survey with experts who issued their opinions through a scale/matrix questionnaire. The second was to demonstrate the feasibility and plausibility of the model through a survey addressed to the specialists who have direct or indirect ties to public private partnerships projects in Brazil: ECOSUL, ECONORTE, CONCEPA, TCU, ARTHESP, ANTT, BNDES, BIRD, BID, DENIT, among others. Next, a survey was conducted with 20 experts, selected according to their technical-scientific criteria. The researcher regarded the: PPP projects managers, concessions of roads managers. Transportation infrastructure planning managers, modeling and knowledge managers. Next, the detail of the phases and steps of the modeling and underlying analysis.

3. Modeling and Underlying Analysis

The purpose of this section is to present the application of the methodological framework, aiming to provide managers of projects on PPP with investments on infrastructure, information, enabling them: (i) to monitor the political, economical and social environment, the regulations, judicial aspects and risks that impact directly or not the organizations; (ii) the best decision as for the contractual negotiation, specially the rights and duties between partners; (iii) the best choice of partners; (iv) the best build-up and management of the project; (v) the best definition of the competition policy; (vi) the definition of tax criteria and the budgetary structure; (vii) the best definition as for investments in projects on road transportation infrastructure; (viii) the best financial engineering management; (ix) the definition of the goals to be met; (x) the management of shared risks associated to these concession projects.

The building-up and the management of a public private partnerships projects require highly complex analytical approaches, which include subjective elements. Thus they demand the technical mastery of various technological, human, environmental, technical, legal, financial and political aspects and procedures. Thus, the current proposal to build up a modeling applied to the PPP project happens within the following proceedings: *Phase 1:* Modeling the needs of information in PPP under uncertainty and unpredictability. This phase is structured in two stages: *Stage 1:*- Identification of CSF *Stage 2:*- evaluation of critical success factors, and *Stage 3:* prioritization of the information needs starting from the crossing of CSF and the Areas of Information in PPP. *Phase 2:*Modeling for the determination of the critical Stakeholders' knowledge in PPP under Uncertainty and Unpredictability.

This phase has been subdivided as follows: *Stage 1* - identification and Acquisition of Knowledge in PPP *Stage 2* - knowledge impact evaluation on PPP performance *Stage 3* - representation of knowledge in mental maps; and *Stage 4* - determination of the effective rate of knowledge priority on PPP performance.

Phase 1: Modeling the needs of information in public private partnerships project performance under Uncertainty and Unpredictability

This phase is structured in three stages: *Stage 1:* determination of the Critical Success Factors (CSF); *Stage 2:* determination of the information areas; and *Stage 3:* prioritization of the information needs starting from the crossing of CSF and the Areas of Information.

Stage 1: Determination of CSF

The concept of "Critical success factors" (CSF) was developed by Rockart and the Sloan School of Management with the phrase first used in the context of information systems and project management (Rockart, 1982). Rowlinson (1999) states that critical success factors are those fundamental issues inherent in the project, which must be maintained in order for team working to take place in an efficient and effective manner. They require day-to-day attention and operate throughout the life of the project.

This phase is focused on determining the CSF, and is itself structured in two stages: (A) identification of CSF and (B) evaluation of CSF. (A) Identification: The identification of CSF is based on the combination of various methods (Liedecker and Bruno, 1984): (a) environmental analysis (external variable: political, economical, legislation, technology and among others.); (b) analysis of the industry structure (users' needs, the evolution of the demand, users' satisfaction level, their preferences and needs; technological innovations); (c) meeting with specialists and decision makers; and (d) the study of literature. (B) CSF Evaluation:

After their identification, the CSF is evaluated in order to establish a ranking by relevance. Here the scale model of categorical judgments designed by Thurstone in 1927 has been adopted. Thus, the evaluation of the CFS is systematized in the following steps: *Step 1:* determination of the frequencies by pairs of stimuli. *Step 2:* determination of the frequencies of ordinal categories. *Step 3*: calculation of the matrix [πij] of the relative frequencies accumulated. It is highlighted though that the results to be achieved in Step 3 reflect the probabilities of the intensity of the specialists' preferences regarding the stimuli, the Critical Factors of Success in this work.

A number of authors have identified factors they consider critical to the success of project procurement under BOOT, PPP or similar concepts. The following list attempts to summarise these: developed legal and economic framework (Tiong, 1990):

favourable inflation, exchange and interest rates (Tiong, 1990); financial capability and support (Tiong *et al.*, 1992); technical innovation (Tiong *et al.*, 1992); appropriate risk allocation (Grant, 1996); avoiding delays and cost overruns (Tiong and Alum, 1997); comprehensive feasibility study (Keong *et al.*, 1997); existing infrastructure (Keong *et al.*, 1997); political stability and support (Keong *et al.*, 1997); a well prepared Environmental Impact Statement (Tiong and Alum, 1997); expertise (Salzmann and Mohamed, 1999); local partner(s) (Salzmann and Mohamed, 1999); shared authority (Kanter, 1999); transparency (Jefferies *et al.*, 2002); commitment (Hardcastle *et al.*, 2005); strong private consortium (Hardcastle *et al.*, 2005); and developing a culture of partnership (Duffield, 2005).

CSF are vital for managers engaging in improvement of their organisation, as they will indicate how much progress is being made in particular areas (McCabe, 2001). Next, the CSFs are grouped for a better understanding. They are grouped in "clusters", according to the tree structure principle, which distributes the CSF into different areas or processes, but always observing the relevance relationships, and supplemented by the pairing or "cluster" methods, in order to gather the sample data into groups (CSF), classifying them in such a way that there is homogeneity within the group and heterogeneity between groups. As a result, a hierarchical structure of CSF is obtained (Figure 2).

The method allows a scale by importance, in order of increasing priority: first, the Political / Market/ Factors; second, the Judicial Factor, third, the Economical and Financial Factor; and fourth, the Technical Factor. Assembling here the many dimensions of the CFSs, the results show that there is a political factor-predominance. This is seen when taking into account the relevancy of public policies for the design of public private partnerships.

Political resolutions on the manner of supplying services are viewed as essential presuppositions for this mechanism's financing feasibility. From the stable political institutional outline, the success and feasibility of the other factors become effective. In view of past experiences in the international and Brazilian scope, the high-level of Political Factor preferences is justified. Undoubtedly, political instability brought forth discontinuity of great and sound projects. The results can be observed in Figure 2 that follows.

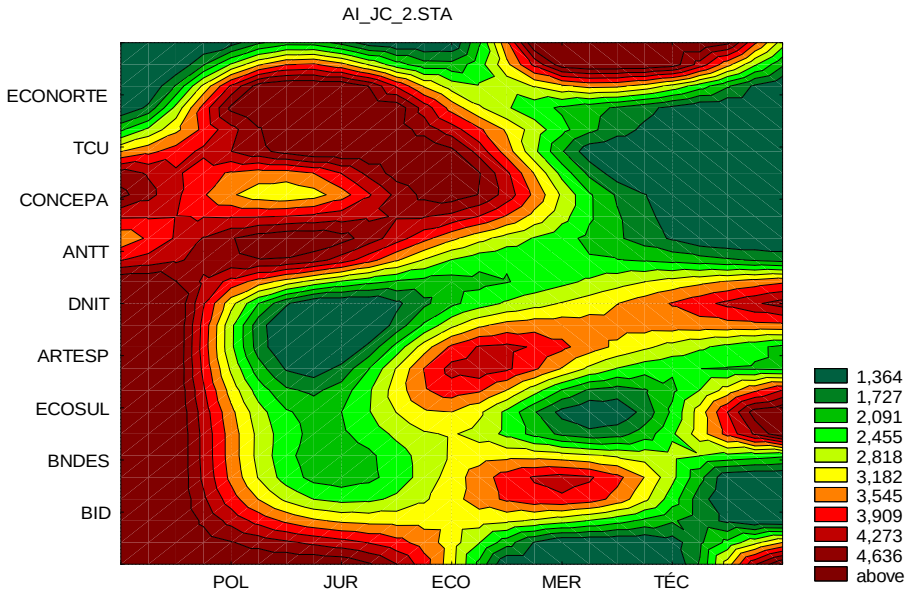

Figure 2: Priority of CSF in projects of PPP

With this scenario, having defined the political factor and its components, it is possible to understand the information that is included in the macro guidelines defined by public policies; the strategic decisions of the governing body, regulating agencies and its qualified entities to regulate, legislate and hire, among others. To sum it up, by developing this factor, it is possible to understand information referring to: the guidelines for strategic planning of infra-structure development, supporting the partnership proposals; the strategic objectives to be reached by PP; the national politics of PPPs, within the context of other options for infra-structure financing: the institutional organization (central and decentralized units of PPP, others.

Stage 2:Determination of the Areas of Information

The CSF having already been defined, the information areas are delimited with respect to the different CSFs. After determining the CSF, the determination of the areas of information ensues. The result has allowed defining four groups that represent the areas of information: *first, the Governmental Area on Public Policies; second, the Market Area; third, the Economical and Financial Area; fourth the Technical Information Area*. The goals of the areas of information define specifically what must be achieved by these areas to meet one or more objectives from the projects (business), contributing for the enhancement of the project performance as to quality, productivity and profitability. Organizations public and private need to use adequate information to check the status of business activities as well as to make informed business decisions (Martin et al., 1998).

According to their tasks, managers must have the adequate information and the ability to analyse and evaluate alternatives in the light of the goal sought. This information comes from different internal and external sources and their credibility is crucial to provide an adequate knowledge (Joyce, 1993).

Stage 3: Prioritization of the information needs starting from the crossing of CSF and the Areas of Information

Again, these information areas are ranked by application of the same Categorical Judgment Method of Thurstone (1927) and put into relation with the CSF. At this moment the following tools have been adopted: Compromise Programming, Promethee II ™ and Electre III ™. These methods rendered their contributions in determining the performance in the areas of information, which led to the identification of Mercadology Area as the most important ones in order to globally ensure the overall critical success factors. The critical knowledge for PPP is determined in the sequence.

Aiming to know which area of the PPP the decision makers must develop a "strong management", the prioritization of information needs takes place. The results shown by the Methods Compromising Programming, Electre III and Promethee II have pointed out the Political Area as the most relevant one to guarantee the CSF. The results are: The result has allowed defining four groups that represent the areas of information: *first, the Governmental Area on Public Policies; second, the Market Area; third, the Economical and Financial Area; fourth the Technical Information Area.*

The gathering, analysis and processing of information must be to strongly reinforce the set of activities that comprise his area, specially in what concerns the information about actions on: to monitor the political, economical and social environment, risks that impact directly or not the PPP projects. Thus, the gathering, analysis and processing of information must be to strongly reinforce the set of activities that comprise his area, specially in what concerns the information about actions on: (i) Institutional and Environment Policies of PPP concessions;(ii) Negotiation on the build-up of projects and the selection of concessionaires; and (iii) General Judicial Environment. In order to do so, the data gathered from the specialists were used.

Phase 2: Modeling for the determination of the critical knowledge in PPP projects in transport infrastructure under Uncertainty and Unpredictability

This phase has been subdivided as follows: *Stage 1* – identification and acquisition of knowledge in PPP projects in transport infrastructure under uncertainty and unpredictability;

Stage 2 – Knowledge impact evaluation on PPP projects performance in transport infrastructure under uncertainty and unpredictability; *Stage 3* – representation of knowledge on PPP projects performance in transport infrastructure under uncertainty and unpredictability; and *Stage 4:* determination of the effective rate of knowledge impact on PPP projects performance in transport infrastructure under uncertainty and unpredictability using neurofuzzy intelligence. This proceeding is shown in details as to its.

Stage 1 – identification and acquisition of knowledge in PPP projects in transport infrastructure under uncertainty and unpredictability

Initially, information topics which have already been identified will be elaborated, analysed and evaluated in order to be understood by the decision-makers during the formulation and the management of a PPP project. Following this, they will be reviewed and organised and validated by PPP specialists. Afterwards, relevant theories and concepts are determined. With respect to the acquisition procedures, the different procedures of the process of acquisition represents the acquisition of the necessary knowledge, abilities and experiences (Stewart, 1997) to create and maintain the essential experiences and areas of information selected and mapped out (Thiel, 2002; Watters et al., 2006).

Acquiring the knowledge (from specialists) implies, according to Buchanan (2002) and Kululanga and Mccaffer (2001) the obtaining of information from specialists and/or from documental sources, classifying it in a declarative and procedural fashion, codifying it in a format used by the system and validating the consistence of the codified knowledge with the existent one in the system (Wiig, 1993). Therefore, at first, the way the conversion from information into knowledge is dealt with, which is the information to be understood by and useful for the decision-making in projects on PPPs. First, the information is gathered. Then, the combination and internalisation is established by the explicit knowledge (information) so that it can be better understood and synthesised in order to be easily and quickly presented whenever possible (the information must be useful for the decision-making and for that reason, it must be understood).

In this work, we aim to elaborate the conversion of information into knowledge. The conversion (transformation) takes place as follows: first, the comparison of how the information related to a given situation can be compared to other known situations is established; second, the implications brought about by the information for the decision-making are analysed and evaluated; third, the relation between new knowledge and that accumulated is established; fourth, what the decision-makers expect from the information is checked (Oliveira, 2004). The conversion of information into knowledge is assisted by the information maps (elaborated in the previous phase by areas, through analysis and evaluation of the information). We highlight that the information taken into account is both the ones externally and internally originated.

The information from external origins has as a main goal to detect, beforehand, the long-term opportunities for the project (Celis, 2000). The internal information is important to establish the strategies, but it has to be of a broader scope than that used for operational management, because besides allowing the evaluation of the performance it also identifies its strengths and weaknesses. Following from this, the proceedings for the acquisition of theoretical background and concepts are dealt with. Such proceedings begin with the areas of information, one by one, where the concept and the theory on which is based the performance of the actions (articulations) developed in those areas that allow to guarantee the feasibility of the projects on PPP are identified.

In other words, which knowledge and theory are required to be known in order to ensure the success of projects on PPP in that area. Then, the analysis of surveys in public and private institutions about the job market for these institutions takes place, bearing in mind the demands of similar areas studied in this work. As for the offer, we intend to search for the level of knowledge required by the companies and other organisations in those areas, as well as what concerns technical improvement (means) for the professionals. After being identified and acquired, the knowledge is evaluated, with the aid of the method of categorical judgements of Thurstone (1927) and artificial neural network (ANN).

Stage 2 - Knowledge impact evaluation on PPP projects performance in transport infrastructure under uncertainty and unpredictability using method of Categorical Judgments of Thurstone (1927) and Artificial Neural Network (ANN)

Evaluation for the categorical judgements' laws method: The result of the preferences is then presented in the order of importance increase. In order to demonstrate the application of the methodological proposal, the results of the objects of knowledge on the 'Governmental Area of Public Policies' were dealt.

Prior to the compared analysis of knowledge, it is important to mention that the results wee extracted from the four categories of the following areas: public policies government management, economic and financial, technical, and marketing/business. Firstly, we established a comparison of all the theoretical bases and concepts and context information, denominated as stimulus by the areas. The results obtained have been satisfying, hence validating the proceeding proposed for assembling and prioritising critical knowledge for projects on PPP, as well as for constituting other elements of the intellectual capital for the concession policies and partnerships, utmost on the road to the investment field.

Evaluation of Knowledge's Objects using the artificial neural network (ANN) (2): The ANN is understood to simulate the behaviour of the human brain through a number of interconnected neurons. A neuron executes weighed additions for the activation of the neurons representing nonlinear relations. The ANN has the capacity to recognise and to classify standards by means of processes of learning and training. The training of the net is the most important phase for the success of such applications in neural network. The topology of the net can better be determined by subjective form, from a principle that consists of adopting the lesser intermediate number of possible layers and neurons, without compromising precision. Thus, in this application, the layer of the entrance data possess 15 neurons corresponding to the 15 0 variable referring to knowledge objects. The intermediate layer possesses seven neurons, and the exit layer possesses one corresponding neuron in a scale value determined for the ANN.

The process of supervised learning based in the back propagation algorithm applying software easy NN, determines the weights between the layers of entrance and intermediate, and between the intermediate and exit automatically. The training process was completed when the weights between the connections had allowed minimising the error of learning. For this, it was necessary to identify which configuration would present the best result, varying the taxes of learning and moment. After diverse configurations tested, the network that best presented results with an equal learning rate; 0.30 and equal moment 0.80.

The data was divided in two groups, where to each period of training one third of the data is used for network training and the rest is applied for results verification. After many topologies of network, and parameters, the network obtained the best results was presented. The network was trained for the attainment of two result groups to compare the best determined scale by the networks.

In the first test, the total judgement of the agents was adopted, however only the second test obtained the best scale, next to the one represented by the method of the categorical judgements. With this, the last stage of the modeling in ANN consisted of testing the data of sequential entrance by random form; this process presented more satisfactory results.

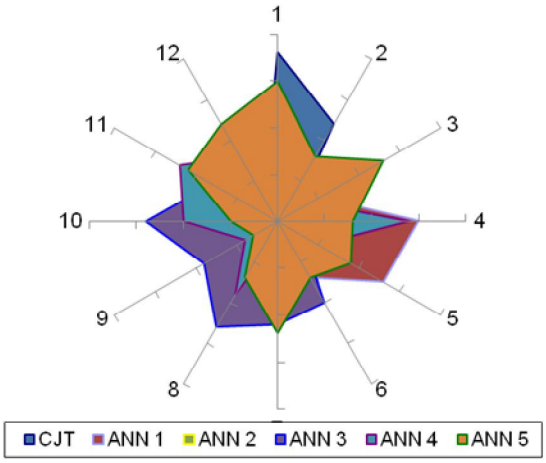

Figure 3: Priority of Knowledge's Objects - ANN and CJL

The attained results proved satisfactory, emphasising the subjective importance of scale methods to treat questions that involve high degree of subjectivity and complexity. With regards to the topologies of the used networks, the results obtained for some configurations of the ANN and then compared with the CJT, it was observed that ANN 1 is the best one if approached by the classification obtained for the CJT. The results can be observed in Figure 3. The prioritising objects of the tool proposals were for PPP knowledge. ANNs as well as psychometric scale (CJT) were restricted only to the specialists' decisions in projects of raised subjectivity and complexity, needing other elements that consider the learning of new knowledge.

However, it is interesting to highlight that the CJT method, as it considers a variable involving a high degree of subjective and complexity and because it works with probabilities in the intensity of preferences, considers the learning of new elements of knowledge. Thus, it can be said that for typology of application, as presented here, it is sufficiently indicated.

Stage 3 – Representation of knowledge on PPP projects performance in transport infrastructure under uncertainty and unpredictability: The goal in building-up a mental map is to make the decision-makers of projects on PPPs understand the decision context better. After prioritising the objects of knowledge, the build-up of cognitive maps take place Governmental Area on Public Policy and Market/business, assisted by the software Statistica. In order to create maps, the denominations of the objects of knowledge have been abbreviated (Figures 4-7). Such factors contribute to the success of the projects, while the contract is made transparent, generating expectations and credibility of the project. In the sequence, Figure 4 shows segregation in the decision-maker's preferences.

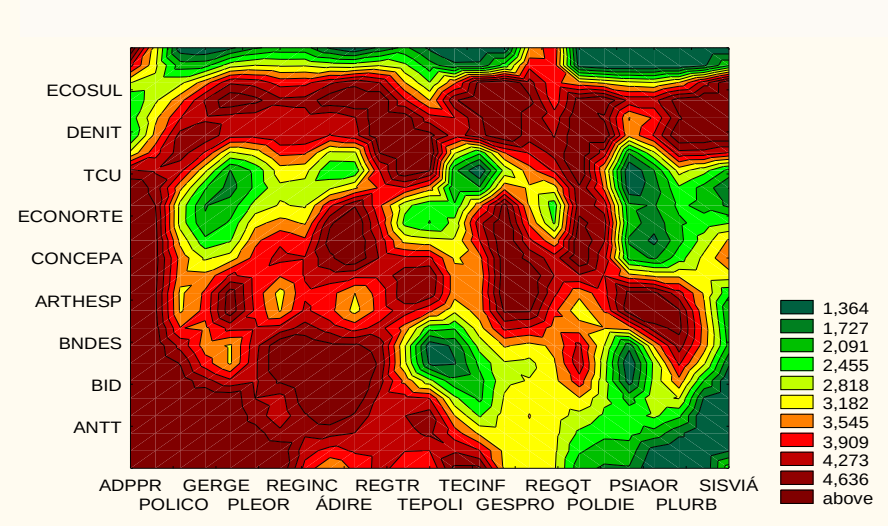

Figure 4: Theoretical bases and concepts according to segregation in the preference intensity of the decision makers – Public Policies Governmental Categorie

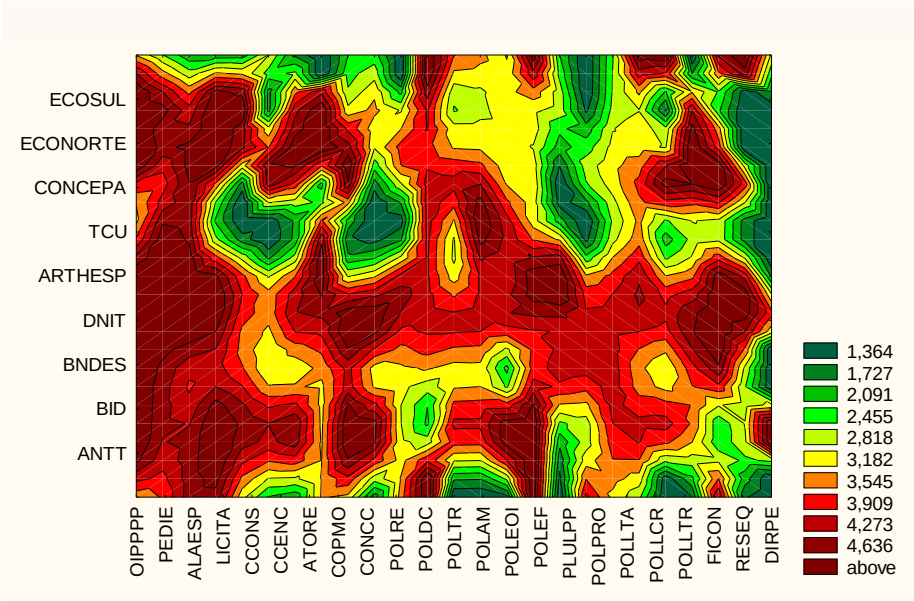

Figure 5: Context information according the decision makers preferences - Public Policies Governmental Categories

With this, it becomes necessary to emphasi knowing the priority knowledge presented, bearing in mind they have to take on an essential role in managing PPP projects. Included in the public and private administration, is O&M, organizational structure, mental models, projects, marketing and organisational development, strategic planning and budget. With regards to policies and instruments of competition, the legal elements of protection are sought, such as defending competition. Figure 6 displays the intensity of the decision-maker's preferences with relation to context information.

Before anything else, it is worth emphasizing that the PPPs managing is viewed from a strategic perspective, planning and coordinating the necessary activities, in order to meet the desired levels of services and quality at the lowest possible costs. By assembling the vast dimensions of knowledge, there is a prevalence of "the best managing practices of "PPP projects management" (NEGO), "Economy" (ECONO) and "Risk Managing" (GROPAR). Unified to this there is the know-how of partnerships and alliances, quality and productivity. The challenge that appears in the PPP project managing is the result of a good practice: (I) shorten the logistic flux; (II) improve view of the logistic flux; (III) consider logistic managing as a system.

Such practices direct towards planning, managing and control of the logistic operations by means of monitoring the documented performance of the value chain, which includes: (I) service levels and the components of costs; (II) control strategies that continuously follow the performance and are used to upgrade the process to place it in conformity when it exceeds control patterns and; (III) control routing that are projected to motivate employees, including additional payment practices for productivity.

With regards to risk management, this work considers as information the methods and organized processes to reduce losses and increase benefits in order to substantiate the strategic objectives. This requires identifying the risks, quantifying risks, selecting risks, decide (avoid or transfer) risks, inform and communicate and follow-up risks completely, exactly, updated and well-timed. With regards to economical aspects, it is worth emphasizing the econometric models, which have been used very much lately in situations including parameters estimations that pertain to relations constructed by the economical theory, as well as hypotheses formulations regarding the behavior of reality as instruments.

In another level, the role of the macro and micro economics is highlighted regarding decisions, as the inflation levels, interest rates, economic guidelines, fiscal policy, investment policies, exchange rate, population consumption, employment and income rate. The Figure 5 depicts the results of the context information from the Market Area. It is relevant to emphasize the knowledge dimensions about the "actors in the PPPs projects sector" (ATORE) and "International Relations" The role of the economic questions stands out (macro and micro), fiscal, investments, interest, financing, costs structure, product price, competition, among others that exert direct or indirect repercussions on PPP decisions (ECONO).

Also recognized is the importance of "managing the relationship of partners and alliances" (GROPAR). There is a subtle homogeneousness of these cognitive elements on PPPs projects management. Time, delivery time, technical assistance and prompt delivery become fundamental.

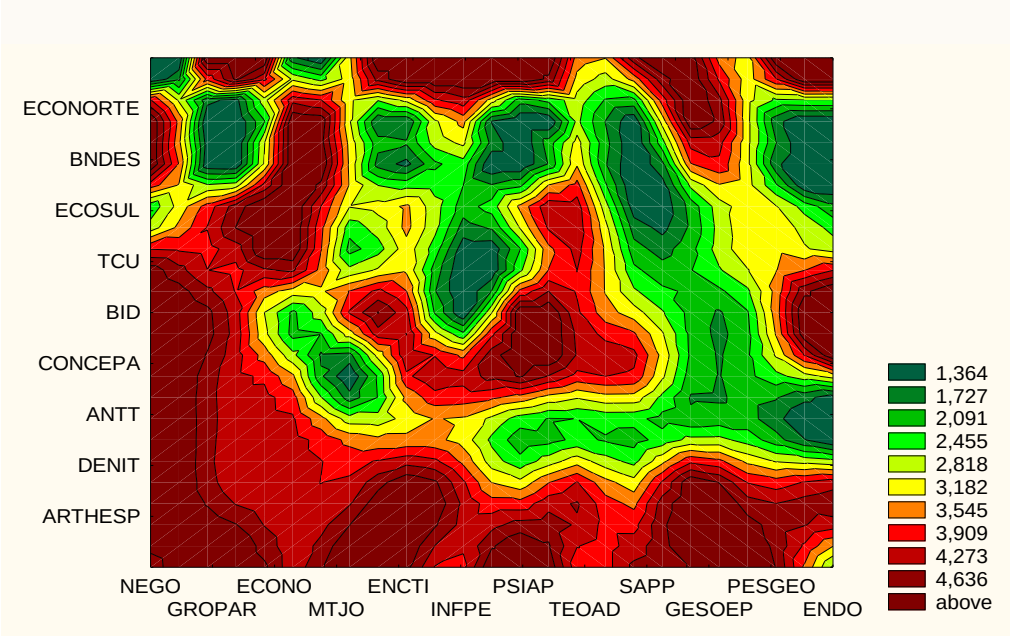

Figure 6: Theoretical bases and concepts according to segregation in the preference intensity of the decision makers – Market/Business Categories

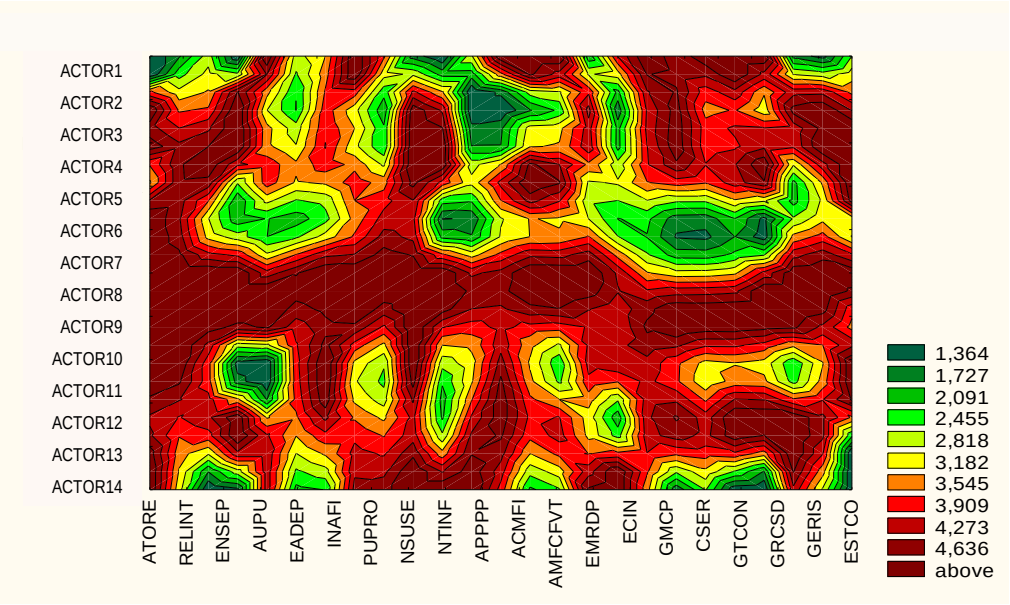

Figure 7: Context information according the decision makers preferences – Market/Business Categories

Moreover, the current market complexity demands that the managing efficacy of product flux surpass the limits from local to global. Within this spectrum, logistics is viewed as a strategic area that enables companies to expand their relationships in the international market, transposing geographic and economic hurdles. Aiming at an integrated global economy, companies are under pressure to think of products from a global stance and to rationalize their productive processes to maximize corporative resources.

Stage 4 – Determination of the effective rate of knowledge impact on PPP projects performance in transport infrastructure under uncertainty and unpredictability Using Neuro-Fuzzy Intelligence

This stage focuses on determining of the effective rate of knowledge impact on PPP projects performance in transport infrastructure under uncertainty and unpredictability using neurofuzzy intelligence. Seeing that it is a process whose attributes mostly have characteristics of subjectivity and the experience of the decision-maker is quite significant, there is a need for a tool that allows the association of quantitative and qualitative variables converged to a single evaluation parameter (Oliveira, 2004; Cury; 1999; Von Altrock, 1997). This model (Figure 9) adds the technology of neural networks to the fuzzy logic (neurofuzzy intelligence). The model captures uncertainties and imprecision in high complexity environments. Here, this model supports the PPP projects managing and is adapted from the model of Oliveira and Cury (1999).

In such neurofuzzy intelligence, the entry data can be quantitative and qualitative and are grouped to determine the comparison parameters between the alternatives. Since the exact models suitable for this type of calculation have a complex application, the neuro-fuzzy intelligence enables and simplifies the human decision of reproducing the process. This modeling is structured from a combination of all of the attributes in blocks of inference that use base fuzzy rules and linguistic expressions, so that the preference for each alternative of knowledge priority decision, in terms of benefits in PPP, can be expressed by means of a “grade” varying from 0 to 10. Within this spectrum, this stage presents a modeling to determine the effective rate of knowledge impact on PPP projects performance in transport infrastructure under uncertainty and unpredictability using neurofuzzy intelligence, based on quantitative information and also on the specialist’s qualitative information, using the neurofuzzy intelligence.

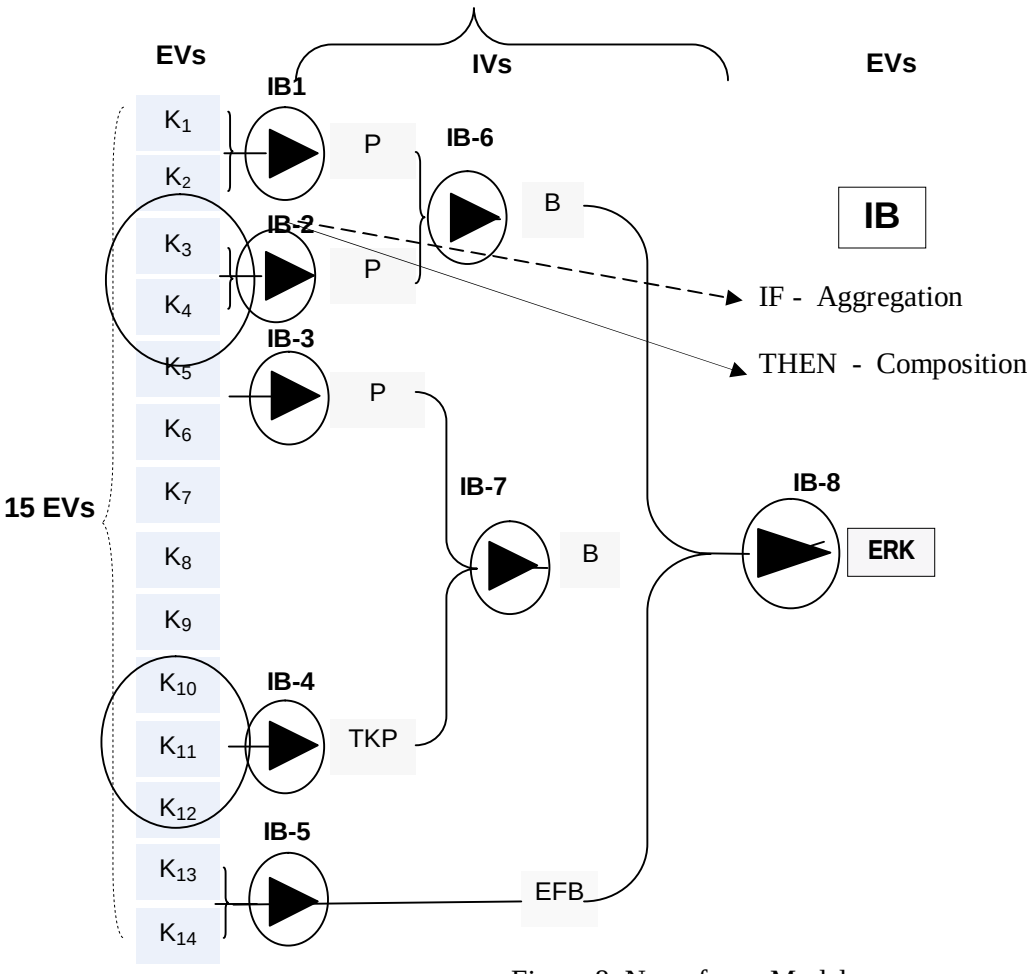

Figure 8: Neurofuzzy Model

The qualitative parameters are difficult to measure and may indicate high levels of subjectivity, hence justifying the application of methods that allow the convergence of these parameters to a single coefficient, therefore enabling the decision-making taking into account all of the relevant attributes. The stages of the model are described to follow:

Stage 3.1: Determination of the Entry Variables and Linguistic Terms

It focuses on determining the entry variables (EV). These variables are categorized according to the quantitative or qualitative types. Also, the linguistic terms attributed to each EV are presented: High, Medium and Low. Thus, the EVs (knowledge - theoretical bases and concepts and context information: Governamental Public Policies (P) Knowledge; Market (M) Knowledge; the Economical and Financial (EF) Knowledge and Technical Knowledge (T)) shown in the Modeling are (Phase 2 – Stage 1). Guidelines of: investments; Demand Risks in PPPs in transport infrastructure (Operating risks; Design and Construction Risks; Risks Market; Risks of Use of Land; political risks.

Institutional and Legal Risks; Projects Risks; Financial Risks; Specific Risks; environmental risks); regulations – legislation; client service/quality; quality; productivity; costs structure; best finance project; productivity practices, market risk; competitive strategy; criteria, organization, proceeding and monitoring of projects; actors; negotiation, practice best in PPP project management; alliances; economy; innovation in PPPs projects; new technologies; issues economics; technological innovation processes; meet demand; competition;; project uncertainty; new managing methods (demand and offer); follow-up of value markets of input; offer and demand of human resources; cash flow; financial engineering; effective engineering; technical and human resources (offer and demand); capital structure; taxes, analysis of social and environmental impacts and their mitigation; Information technology (Best Practices); Indicators practiced by the market; and monitoring the competition, among others.

After their identification, the theoretical bases and concepts and context information (knowledge) were evaluated in order to establish a ranking by relevance. Here the scale model of categorical judgments designed by Thurstone in 1927 has been adopted (Phase 2, Stage 1). These variables were extracted (15 variables/ranking - classification) from the independent variables.

Stage3. 2: Determination of the Intermediary Variables and Linguistic Terms

The entry variables go through the process of fuzzy inference, resulting in linguistic terms of Intermediary Variables (IV). Thus, the linguistic terms attributed to the IV were: Low, Medium and High, including some variables: Slow, Moderate, Fast – Bad, Regular and Good. The extracted intermediary variables were: Political Performance; Judicial Performance; Market Performance; and Economic and Financial Performance; CONFIGURATION Political Benefit; Judicial Benefit; Market Benefit; Technical Benefit; and Economic and Finance.

The proposed design is made up of seven configurations of fuzzy specialist systems, one or two entry variables (EV) that go through the fuzzy process and through the inference block, therefore producing an exit variable (EXV), designated intermediary variable (IV). In turn, such IV joins with another IV, hence forming a set of new EVs, consequently configuring a sequence until the last layer of the network. In the last layer, the definite variable EXV of the neuro-fuzzy modeling is produced. This EXV then undergoes a de-fuzzing process to achieve the final result: the PPP decision.

Stage 3.3: Determination of the Exit Variable – Effective Rate of Knowledge Priority onPPP performance Using Neuro-Fuzzy Intelligence

The Exit Variable (EXV) of the neuro-fuzzy model proposed was denominated effective rate of knowledge priority on PPP projects performance , resulting in the processes of:

Fuzzyfication: This process includes determining the functions for each of the entry variables. If the entry data, the calculation results and observations are precise values, then it is necessary to perform the structuring of the fuzzy arrangement for the entry variables, which consists of the fuzzyfication process. In case the entry variables are obtained in linguistic values then the fuzzification process is not necessary (Cury, 1999). The fuzzy arrangements can be characterized as a generalization of the Boolean sets, where the pertinency function can assume values at fixed intervals. Usually, the interval [0,1] is considered, when it is not correct to assume that an element belongs to a specified set, but that it does indeed present a certain degree of pertinency. Therefore, a fuzzy set, besides an X universe, is a set of orderly pairs represented by Equation 1.

$$A=\{(\mu_A(x),x)|x \in X\} \quad (1)$$

Where $\mu_A(x)$ is a function of pertinency (or degree of pertinency) of x in A and is defined as the mapping of X in the closed interval [0,1], in agreement with a Equation 2 (Pedrycz and Gomide, 1998).

$$\mu_A(x):X \rightarrow [0,1] \quad (2)$$

Fuzzy inference: The ground rules of fuzzy inference is made up of the IF-THEN type, which are responsible for the association of the entry variables and the generation of the exit variables in linguistc terms, with their respective pertinency functions. The fuzzy inference is structured by two components: (i) aggregation, which means the computing from the SE of the rules; and (ii) composition, regarding the THEN part of the rules. The Degrees of certainty (DoC) that determine the linguistic vectors resulting from the processes of aggregation and composition are defined by the Equation 3.

$$GdC;:max[FC_1 . min\{GdC_{A11},GdC_{A12},...,GdC_{1n}\},...,FCn . min\{GdC_{An1},GdC_{An2},...,GdC_{Amn}\}| \quad (3)$$

Defuzzification: In some applications the interpretation of a result is enough, as for instance, when a qualitative or verbal response is desired. However, in other applications, a numeric value as a result from the system is deemed as necessary (as for instance, arrangement and comparison). In these cases, after the fuzzy inference, a defuzzification process is necessary, that is, transform the linguistic values from their pertinency (Von Altrock, 1997) functions.

Usually, the Maximum Center method to determine an exact value for the Exit Variable linguistic vector is used. From this method, the certainty degree of the linguistic degrees are defined as "weights", associated to each of these values. The exact resolved value (RV) is determined by considering the weights in relation to the typical values (maximum values of the pertinency functions), in agreement with the definition of the Equation (Von Altrock, 1997)

$$RV = \frac{\sum_{i=1}^{n} DoC_i \cdot X_i}{\sum_{i=1}^{n} DoC_i \cdot X_i} \quad (4)$$

Where DoC represent the degrees of certainty of the linguistic terms of the final exit variable and X indicates the typical values for the linguistic terms that correspond to the maximums of the fuzzy sets, which define the final exit variable.

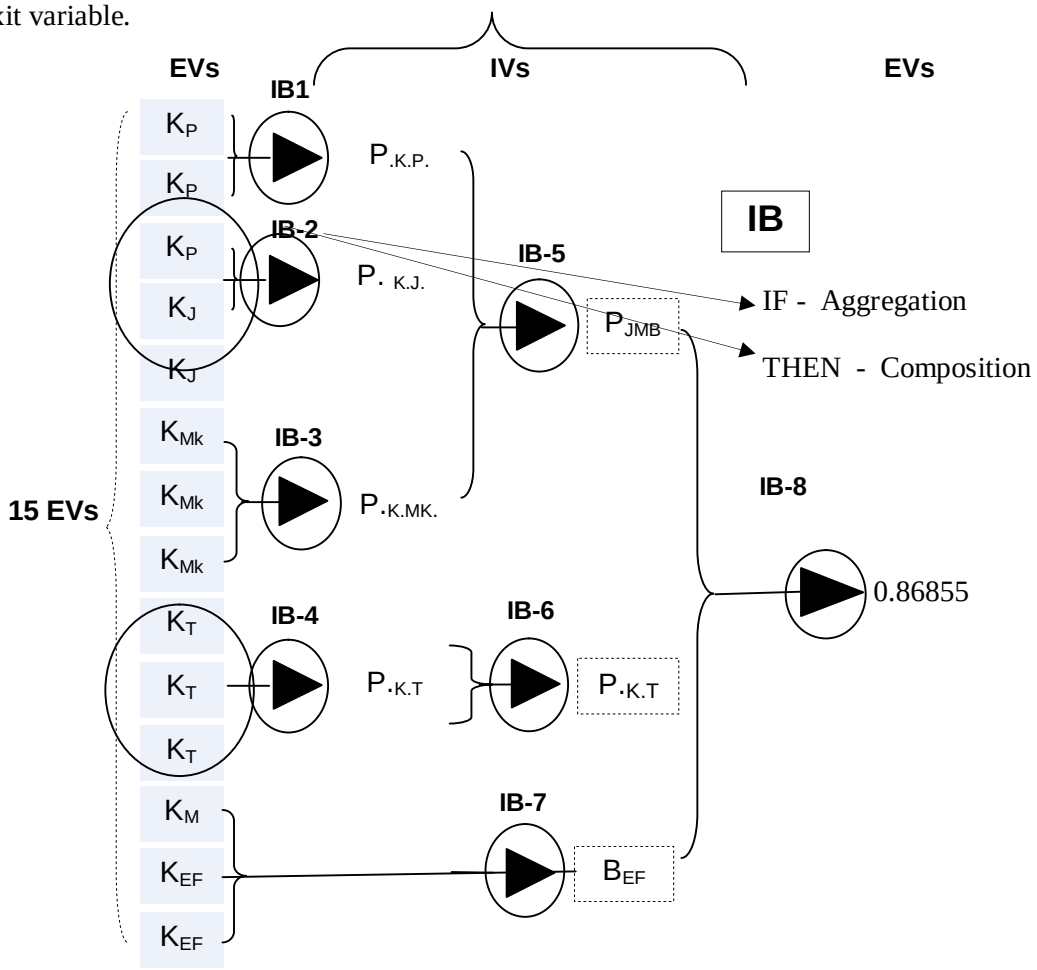

Figure 9: Neurofuzzy Model

The results can be seen in Figure 8, extracted from the Neurofuzzy model, which associates the EVs with its intermediary and exit layers, by means of inference blocks, where the inference rules for each pair of the considered variables are contained. The result of the implementation (EVs – Knowledge – Political/Judicial/Market; Technical; and Economic and Financial) is the rate, defined between 0 and 10, in an increasing scale according to the adequate decision-making on knowledge in PPP projects managing, regarding benefits for performance. The effective rate of knowledge impact on PPP projects performance in transport infrastructure under uncertainty and unpredictability Using Neuro-Fuzzy Intelligence is 0.8685 (Figure 10).

This result confirms the hypothesis *H: The effective rate of knowledge impact on PPP projects performance in transport infrastructure under uncertainty and unpredictability is positive and depends of the interaction of the knowledge.* The result of each implementation (exit variable – effective rate) is the defined between 0 and 10, in an increasing scale according to the adequate decision-making on knowledge impact in PPP performance, regarding benefits for performance.The effectives rates of knowledge impact on PPP projects performance in transport infrastructure under uncertainty and unpredictability using Neuro-Fuzzy intelligence are: Political – 0,7927; Market – 0,7392; Economic and Financial – 0,6018; and Technical – 0,5192 (Figure 10).

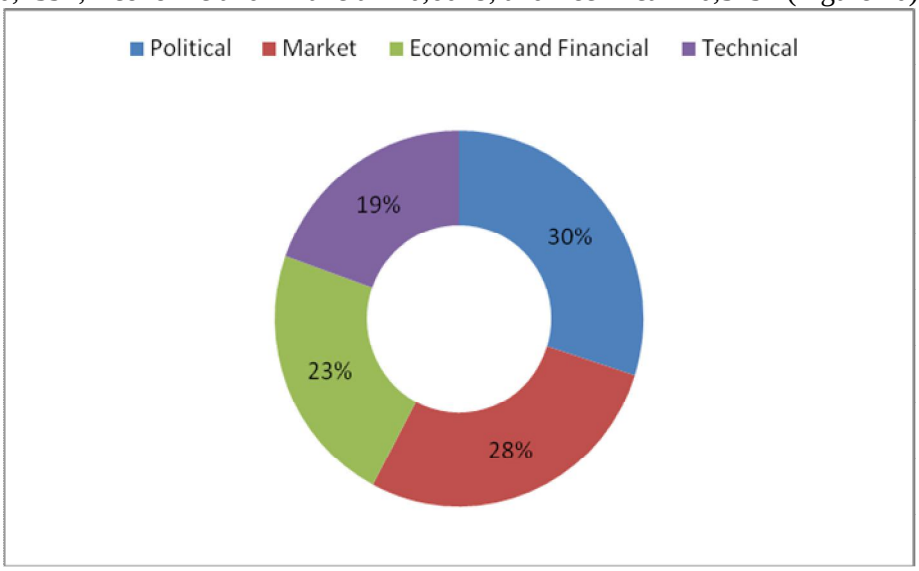

Figure 10: Effective rate of knowledge impact on PPP projects performance in transport infrastructure under uncertainty and unpredictability using neurofuzzy Intelligence

The effective rate indicates choosing the best alternative to concentrate the endeavors on PPP managing. Meaning, that at first sight, it is vital to focus on monitoring the external ambient (Market and Politics), afterwards, the Technical and Economic and Financial issues (internal ambient). It should be taken into account that comparison among variables should take place permanently and recurrently. Comparatively, the Political alternative demonstrated greater of the effective rate of knowledge impact on PPP projects performance in transport infrastructure under uncertainty and unpredictability using Neurofuzzy intelligence. With regards to the Market and Politics variables, special attention must be given to PPP external variables. Allied to this, a space opens up to define the new managing strategies, while seeking to make the decision spectrum more intelligent. For decision choosing, the neuro-fuzzy model is a more efficient instrument to compare options. From the association of intervening objective and subjective variables in the decision choosing process, through a hierarchic neural network using a fuzzy inference process to convert information, it is possible to generate a numeric value denominated effective rate of knowledge impact on PPP projects performance in transport infrastructure under uncertainty and unpredictability.

Knowledge priorities of Brazil's PPP projects in transport infrastructure

With regards to the political conjecture, we have already discoursed and know that for a long time it has been an obstacle for the development and growth of the country. Specifically the transport sector, one of the most impaired, frequently witnessed discontinuity of projects and relevant programs. It is also noteworthy that despite mentioning the political factor as the most representative of that list, a huge list of factors are identified that are essential for conducting a PPP, there are about 80 factors identified, which were aggregated (clusters). The proposal of the government is to establish a unit manager of PPPs projects formed by work teams of the very PPPs units, and would also count on external teams hired. However, the way the activities are systematised can make the PPPs projects unsustainable, considering that areas of necessary information are huge to comply with the required actions for each PPP project. Therefore, this proposed structure must be reformulated.

It should be recalled that in the administration of the current government a managing body with the power to coordinate activities related to PPPs projects is foreseen. However, it should be noted, that it is in the interest of the government to train the Federal Public Administration employees involved in PPPs projects.

Such training should happen from the goals and objectives pursued by the state and by private enterprise. Once defined the goals for the desired results, it is necessary to organise the means intended for such goals to be achieved. Relevant issues with regard to capacitation should be considered as: 1 - the skills needed to achieve the expected results 2 - expectations of change in activities based on changes concerning goals, guideline priorities, technological advances and the process of temporary hiring? 3 - the strategies for hiring, redistribution, training and retention (incentives) that should guide accomplishing the projects 4 - the statutory, administrative, structural or cultural barriers identified for human resources training. Following the guidelines, we have just mentioned, for the national training guidelines in the field of PPPs, proposed here, the government and business areas and the general public should be aware of the importance and convenience of partnerships, as well as the training of human resources for developing and managing partnership projects. Such a network would have the role of diffusing knowledge.

Initially, one of the first goals of the training program should be assembling a trained interdisciplinary team. The network would rely on specific functions in the development of national expertise and know-how in the fields of project design, implementation of bidding procedures, projects assessment, process operations, hiring, coordination and management of projects, auditing, political leadership, and the formation of knowledge in PPP projects. Generally, the network would have the following powers: 1 - dissemination of the PPP concepts 2 - the development of the PPP unit structure 3 - its training in the various critical themes for the design and management of PPP projects 4 - case selection of pilot projects 5 - prospecting and drawing in of interested agents for the pilot projects 6 - removing institutional obstacles 7 - sponsoring feasible studies of partnership projects 8 - sponsoring viable projects 9 - assisting public sectors in bidding for PPPs and closing of contracts 10 - monitoring PPP policies and projects 11 - promoting changes in policy and legislation 12 - promoting activities, with the support of universities and research centres, training activities for human resources and scientific and technical development; and 13 - serve as a central information resource centre of PPPs. To follow the thematic priorities of knowledge are listed (Figure 11), which requires urgency in the viability of a public private partnership project.

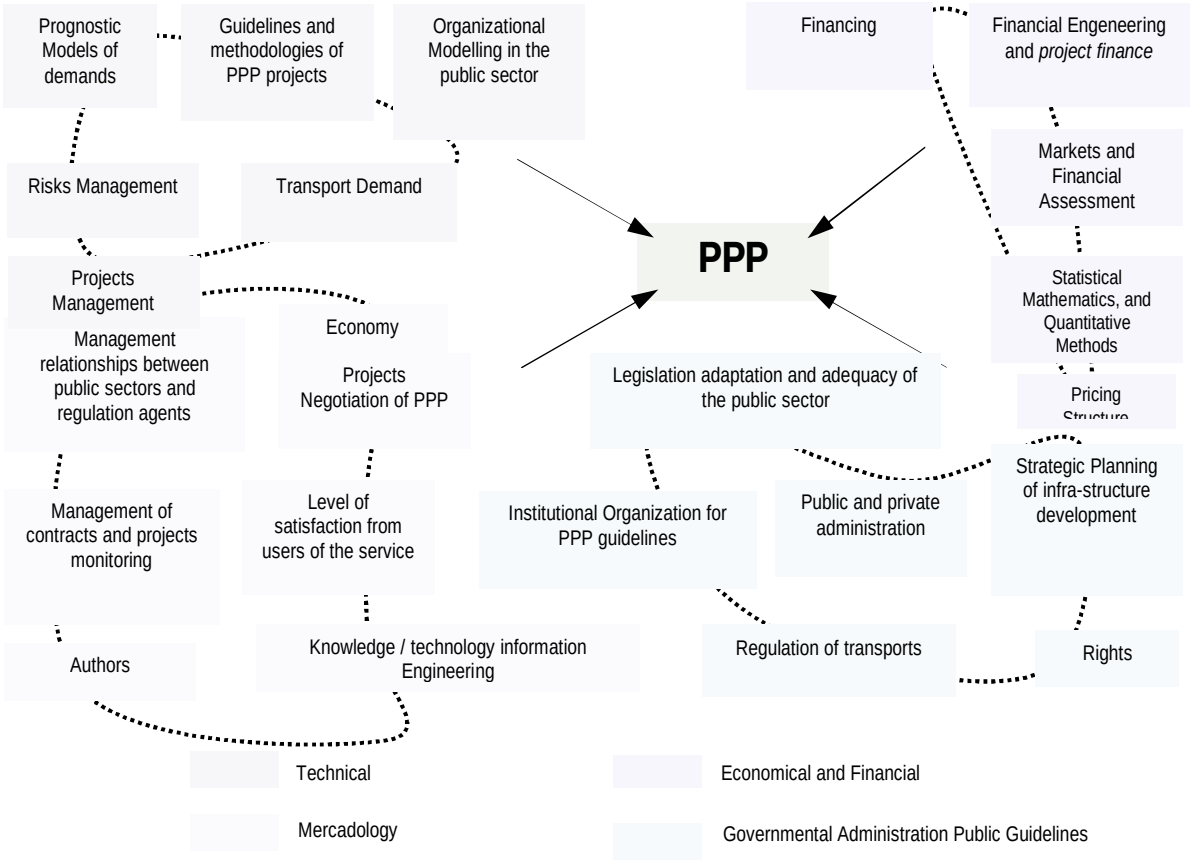

Figure 11: Prioridades temáticas críticas para o desenho e a gestão de projetos de PPP

These are mapped as thematic clusters: 1 ‘governmental public guidelines’2 ‘economic and finance’ 3 ‘mercadology/negotiation’4 ‘technical’. By gathering the cognitive elements, it can be seen that this strategy requires a priority dynamics, which is dependent on the initial state of training, on the concrete characteristics of the projects and a policy of partnerships and cognitive problems that emerge during the practice, always putting in view new contents. For this, priority researches must be permanently and recurrently applied.

6. Conclusions and Implications

PPPs as a way of funding public transport infrastructure . Contractually, megaprojects are often defined in terms of Public Private Partnerships (PPP), in which there is a structural cooperation between public and private parties to deliver some agreed outcome (Turner, 1999; Koppenjan, 2005). Thus, to be successful, PPP must be introduced with an appropriate organisational structure and within an appropriate legal environment PPPs projects are characterised as uncertain, complex, politically-sensitive and involving a large number of partners (Clegg et. al., 2002; Antikoye and Beck, 2003; Hodge, 2004; Klijn and Teisman, 2000; Marrewijk et. al., 2008).

Increasingly, complex and extensive civil engineering and construction projects resemble megaprojects, as they too set up an integrated project organisation combining different organisations’ skills, designs and constructs; and in some instances, not only build, but also operate the facility Clegg et. al., 2002; Antikoye and Beck, 2003; Hodge, 2004; Klijn and Teisman, 2000; Marrewijk et. al., 2008). In selecting partners, governments need to consider issues such as compatibility of objectives, resources, types of learning, leadership styles, and organizational cultures, because different interests may require different knowledge.

This work intends to contribute to the planning guidelines in the field of high complexity spectrum. Thus, it develops a multi-model proposal to assess the impact of knowledge on public private partnerships projects performance under uncertainty and unpredictability. This research treated Brazil’s transport infrastructure as the empirical targets. Here, the modeling approach presented gains emphasis, such diversity of methods when combined are valuable tools with great potential and significant added value, contributing to the robustness of the modeling. The feasibility of the neuro-fuzzy technology, especially in the interaction of qualitative and quantitative variables used in the modeling process, is instrumental for determination of the effective rate of knowledge impact on PPP projects performance in transport infrastructure under uncertainty and unpredictability.

In light of Knowledge Theory and its techniques here listed, it was possible to develop a modeling and contribute to build the knowledge in the field of PPP Management. Trough this modeling a more pragmatic and efficient guidance is sought, assisting the guidelines for long-term PPP Managing, hence assuring this segment’s competitiveness. Extensive and systematic procedures should be pursued that are capable of uniting the most diverse dimensions of PPP Management, surpassing the non-scientific practice often pervading some of the works. This proposal focuses on highlighting unexplored questions in this complex design. However, it evidently does not intend to be a “forced” methodology, but intends to render some contribution, even through independent course of actions.

The modeling proposal developed here differs from other methods of decision support because it extracts the tacit knowledge and converts it into the managers’ explicit knowledge about projects on PPP and concessions. The approach of this work is to make the decision scope more intelligent, making available the knowledge on the development and the management of projects. This proposal is an additional tool available to managers, which helps to greatly reduce the uncertainty of decisions. There are of course several issues to be further explored in other such studies, and is hoped that it contributed to a plausible modeling discussion, with much still to be explored. Of the findings of the state of the art and state of practice.

It is reasonable to state that this research is vulnerable to criticism. This study includes several limitations as specified below, which also helps to identify potential areas for future studies. Firstly, the study is based on the state of the art to establish the structure and contents of the model. With this spectrum, any attempt to consolidate a reconstruction and a consistent interpretation requires, first of all, analyzing the appropriate literature of events, produced by facts acquired through reliable research, i.e., extracted under conditions to obtain results that are closer to reality. And the first question about the construction or reconstruction of a model is with regards the selection, made from a profusion of events and facts that can be considered.

In the research, cross-sectional data used in this study may not be appropriate to establish fundamental relationships between variables, but as referenced by Kenny (1979), the relationships that use cross sections are satisfactory and popularly accepted in relationship tests. Furthermore, a survey was developed for PPP projects in Brazil/road Concessions - Transport in a static context, which may represent a limiting factor. Therefore, it is recommended to reproduce and replicate the model in PPP projects from other countries in order to confirm the results.

It is also recommended that the knowledge dimensions should be extracted from the state of the art, but strongly confirmed by the state of practice, by the judgment of other experts (from other countries), taking into account that values, beliefs, cultures and experiences are determinants in the assessment, which can overturn the effects on the results. It is also underscored that the methodologies and technical basis of this modeling should undergo evaluation by a multidisciplinary team of specialists permanently and periodically, hence proposing possible additions or adjustments to these methodologies. And also replace some of the technical implementations used herein by others, in order to provide a similar role to verify the robustness of the model.

Of the research findings, the PPPs undertake the ever-fast changes, intense competition and a highly uncertain and risky environment.. Knowledge is crucial for PPP performance. This logic will be maintained, however only through opening spaces for the various strata: partners, suppliers and customers. Nevertheless, the capacity to PPP in transport will have to be anchored in efficient planning policies. One can argue that Brazil's PPP still has a long way to go and also has tremendous growth potential. Hopefully Brazil can become a competitive nation.

This paper is aimed at an important area for Brazil where there is a new commitment to PPP management as a way of funding logistics. To be successful, PPP Management must be introduced with an appropriate organizational structure and within an appropriate environment. The Brazil is still in a disadvantageous position when compared to other international experiences: it lacks material, technological and human resources, rendering impossible the feasibility of projects of such greatness. Knowledge is insufficient. In this scenario, our modeling contribution is highlighted, because it provides with support for the critical priorities for the implementation of this project and is directed to building up of the intellectual capital as a key element for the development and management of PPP Management. We are looking forward here to a more practical and efficient orientation supporting its long-term goals and assuring the national competitiveness concerning the category of priorities.

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