

Designing Successful Business Strategies for Private Public Partnerships: An Ontological Approach

Abstract

Purpose

The purpose of this paper is to present an innovative approach for the strategic design of Public Private Partnerships (PPP) and Private Finance Initiatives (PFI) based on ontology.

Design/methodology/approach

Adopting a historic approach, it introduces a posteriori knowledge, deriving from the scheme's stakeholders at the construction and implementation phase of PPPs. Continuous failures of these collaboration schemes and initiatives underline the necessity for a novel project structure. The conceptual argument is based both on empirical and epistemological approach. It integrates the value added of the ontological theory in the PPP/PFI business strategy.

Findings

The research emphasises contemporary design gaps of their current structure and proposes an ontological redesign. The proposed redesign produces a conceptually innovative scheme, which enhances the value added business strategies and their objectives to the structure of these collaborating schemes.

Practical implications

The ontological design of this paper is useful for academics and business consultants around the world and especially in Europe for the successful growth and development of such dynamic collaborations.

Originality/value

Enterprise ontology bridges conceptual and structural gaps of strategic objectives, which are primarily responsible for the failures of PPP collaboration.

Keywords –PPP/PFI, enterprise ontology, business strategies, business redesign, business innovation

Paper type – Conceptual Paper

1. Introduction

Effective and sustainable private PPP/PFI schemes are becoming massively important in an era of crisis where high public debts seem to rule the global economic environment. PPP and PFI schemes are interrelated. PPP is defined as a partnership between public and private sectors,

based on a long-term structural agreement. It involves innovative financing scheme, identified as PFI that requires, in its basic form, a Design, Build, Finance and Operate (DBFO) system (Villani and Phillips, 2017; Fewings and Henjewe 2005). Such schemes provide an important comparative advantage for countries under crisis towards the attraction of international investment. PPP projects are internationally present in more than 85 countries (OECD, 2008). The PFI is a form of a PPP that was introduced in the early 1990s in the UK, but there is also global interest towards investing in such collaboration schemes (Wang et al, 2020; Regan et al, 2009; Holden, 2009). The most important reasons for the introduction of the PPP/PFI schemes into a country's infrastructural development are four. First, the funding of private investors provides relief from government budget constraints (Wang et al, 2020; Eadie et al, 2013). Second, the valuable experience necessary for providing knowledge transfer to a project's design (Zhu et al, 2017; Oteng and Adjei, 2012). Third, an innovative expertise towards the initiation and development of a novel product or service relative to a country's infrastructural needs (Barlow et al, 2008). Finally, the government's opportunity to concentrate on services with high impact factors rather than other ancillary ones (Dewulf and Garvin, 2020).

The World Bank also emphasises all of the above reasons including expectations gaps between public and private sectors, lack of clear government objectives and complex decision-making (Steinmetz, 2017; Zhang, 2005). These reasons qualify PPP business practices worldwide as significantly different from the traditional strategic alliances and tenders. Historically, their main differences are: i) the competitive bidding process (Thomson, 2009); ii) an appropriate balance of financial and operational risks between the project's stakeholders (Shaoul et al, 2006); iii) the private sector expertise and the innovative process (Lonsdale, 2005); and iv) the improved public services and facilities (Thomson, 2009).

Although PPP schemes may appear promising, many of them fail (Jiang et al, 2018; Gang and Gang, 2017). Empirical studies underline that besides their worldwide dispersion, a series of strategic objectives are incrementally exposed within their augmenting implementation due to multiple and diverse factors and uncertainties affecting them (Koppenjan, 2005; Zangeneh and McCabe 2020). Therefore, there is a need to bridge this research gap with a conceptual approach that supports objective PPP operation and structural flexibility necessary to adapt to each country's legal and business environment (Dewulf and Garvin, 2020; Koopmann, 2019; Pantelias and Zhang, 2010).

1.1 Background of the PPP/PFI Collaboration Problem

Since the first decade (1992-2002) of PPP/PFI implementations structural gaps were clearly visible, especially internationally, denoting high costs, low efficiency and unreliability (Ameyaw & Chan, 2013). These gaps carried on towards the projects' second implementation decade (2003-2013) indicated that there is still a massive importance in the construction and development of such collaboration schemes and initiatives (Effah and Chan, 2013). The argument towards the translation of the project concept into reliable project remains a strong research requirement for its economic viability, as the process of PPP institutionalisation remains undermined. (Casady et al, 2018; OECD, 2008). Empiricism that has been drawn from their applications concerning infrastructural projects (e.g. hospitals and bridges) underlines the absence of diverse CSFs responsible for the projects' failures.

A common international practice, at the construction stage, refers to public servants often negotiating complex demands and preferences without the necessary business knowledge or experience (Wang et al, 2020; Pitman and Holve, 2009). Results of such practices are devastating for all stakeholders due to lack of CSFs in the PPP's value chain of activities (Microlinks, 2009). From the one hand lack of CSFs relating to primary activities, lead to servicing problems, high customer volumes and customer diverse demands as well as servicing patterns (Zhu et al, 2017). From the other hand lack of CSFs relating to secondary activities include the unbundling of infrastructural and project management posing threats to supporting services (e.g. cleaning, energy and security services). As these services fall between the project's scope of management (e.g. for a hospital they relate to clinical management) and infrastructural management may pose a threat to the project's efficiency. According to Zangeneh and McCabe (2020), ontology for project knowledge representation facilitates data collection, processing, and utilisation for megaprojects.

Simultaneously, different patterns of managerial decision-making, most of the times from different stakeholders (e.g. clinical and infrastructural management), is used for optimising mutual strategic PPP concepts and principles in effect. These missing CSFs usually generate: i) conflict of interest and lack of transparency (Villani, 2017; Gupta, 2002); ii) lack of synergies and communication (Tsoukas and Vladimirou, 2000); iii) business operative inefficiencies of the stakeholders (Omobowale, 2010); iv) poor business operation structure of the Special Purpose Vehicle (SPV); and v) managerial monitoring gaps among stakeholders (Osei-Kyei et al, 2017).

Throughout the years, PPP problematic implementation is evident due to the underscoring results achieved, where selected case studies investigated the Value for Money (VfM) Critical Success Factors (CSFs). Cui et al. (2018) analysed the existing practices to explore the status quo, trends, and research gaps for PPP infrastructure projects to reduce arbitrariness and subjectivity in this field. Results vary according to the industry and country (KPMG, 2010). Historically, one of the main issues is the problematic conceptualisation of the CSFs Value Added (VA) parameter that derives from the scheme's design (Jingfeng et al, 2009).

A similar study of Villani, et al. (2017) analyses the PPP structure focusing on the organisational mechanisms and processes that are implemented in project's governance. Specifically, the project's assets and organisational processes. It suggests the development of a value added model, which enhances the business effectiveness by bridging cultural gaps among different stakeholders. Gang and Gang (2017) supplement Villiani et al. (2017) by rethinking the PPP with an unbundling approach. They consider that PPPs are high on risks and uncertainties. Therefore, it is necessary to progress with short-term flexible, modular and simple arrangements towards an effective management, instead of long-term, rigid and complex objectives. A similar study examines the knowledge gaps in PPPs' infrastructural processes, and suggests the adoption of knowledge management tools for managerial practices (Boyer, 2016). Accordingly, the application of the KPIs and other financial and accounting processes (e.g. budgeting and costing) was found problematic (Chou, Vassar, & Lin, 2008). KPIs problematic implementation is also augmented due to strong governmental regulatory control mechanisms applied over their private partners with respect to "safety net" qualitative processes and budget approvals (Chen et al, 2017; Eadie, 2013).

Concluding, PPP/PFIs are not conceiving or linking potential CSFs towards efficient design and effective implementation of operational activities. Specifically, they lack business objectives' prioritisation towards primary and secondary processes relating to VfM service. Thus, KPIs lack minimum threshold levels of: i) VfM services; ii) consumer oriented criteria; and iii) efficient planning and allocation of resources. As a result, the historical data of PPP/PFI remains internationally problematic. The aforementioned studies' results underline the importance of design conceptualisation and communication patterns, as they are very important for the schemes' success. It is also important that both public and private partners should clearly comprehend the various business contractual mechanisms and objectives, as well as the risks associated with them (Dewulf & Garvin, 2020; Yuan et al, 2018).

1.2 The Role of Enterprise Ontology in a PPP

It is evident that lack of essential design conceptualisation based on current methodologies creates strategic business gaps, relating to project's objectives, CSFs and KPIs. The scheme's design fails to address its promising potential indicating an undecided future of such collaborations. According to Steinmetz, et al. (2017) the use of ontologies optimises the information flow and conceptualisation among diverse business domains and sets of stakeholders. The role of enterprise ontology is to produce a successful scheme design and implementation (Von Rosing & Von Scheel, 2016). Contemporary ontology (Jiang et al, 2018; Yolles, 2004), although preserves its original roots, where an "on" according to the Greek philosopher Aristotle is something that exists. It also has a very practical and finite role. It assists in developing a common understanding in a business design comprehension among stakeholders with different sociocultural and scientific background.

Based on the background of the problem, the main objectives of the ontological redesign is to present a novel business design for such collaboration schemes, to have a flexible sociocultural design for an international environment adaption and also to present an objective evaluation framework that produces measurable PPP/PFI contract linked results. Enterprise ontology and its related methodology (Dietz 2010), engages to a holistic business structural approach. It produces a conceptual framework of actors, due to: i) formal and explicit specification of an objective conceptualisation; ii) potential for sharing and communicating such conceptualisation among stakeholders; iii) transparent and objective system design; and iv) potential for an interoperable and expandable formal structure with apparent processes.

Enterprise ontology and its functionalistic nature dichotomises between the project's business parameters defining them as subjects and objects. From a constructivism's approach, adapted in this study, a novel scheme of a PPP project should focus on the design interpretation among the project's stakeholders. It should eliminate ambiguous understandings entailed in the different phases of PPP creation. Ambiguous overlapping and subjective interpretations are, among other reasons, mainly responsible for the PPP failures.

Historically, failures derive from lack of clear processes that generates confusion due to different and occasionally overlapping readings and anticipated expectations (Thompson, 1993). Such schemes in order to capture business oriented semantic gaps should link the process of designing and construction with a formal, explicit and common understanding conceptualisation. The enterprise ontology that follows will provide a redesign methodology

that would potentially capture successfully a business oriented sociocultural consensus among the scheme's stakeholders.

2. The PPP/PFI Ontological Redesign

The redesign methodology development proposed has its roots to Business Process Reengineering (BPR) (Raoa, 2012) and enterprise ontology. The methodology is the Designing and Engineering Methodology for Organisations (DEMO) (Dietz, 2006). The redesigned scheme will embrace three distinct systems: social, conceptual and technical. The social system will provide a clear business essence of the scheme's strategic objectives and the conceptual system will provide the required level of information necessary (Ren et al, 2019), based on CSFs, for KPIs implementation. The technical system will introduce the minimum technical infrastructure of business intelligence to support the social and conceptual system.

DEMO will assist in understanding the interrelationships among these three systems (social, conceptual, technical) and their actors towards the successful implementation of such complex collaboration schemes. These three systems embedded in enterprise ontology will comply with the PPP/PFI redesign process. The redesign process is exhibited in figure 1.

2.1 The PPP/PFI Redesign Process

The redesign process presented is defined as the holistic process of a series of steps necessary to capture the business knowledge, from an ontological perspective, relating to development and implementation of the collaboration scheme (Chen et al, 2017). All systems (social, conceptual, technical) forming this collaboration scheme will be defined as systems once they comply with four sets of properties. First, it is the composition. The set of actors and elements participating in each system category. Second, it is the business environment. The set of actors and elements included in the internal business environment (system Kernel) of the PPP/PFI framework and the elements included in the external business environment of the PPP/PFI framework as well as their interaction. Third, is the production of the actors and other elements in the composition that produce the PPP/PFI collaboration contract. Finally, it is the structure. It influences and ties among different system actors and their elements within the PPP/PFI internal and external business environment.

These ontological properties would determine the CSFs of the internal and external structural requirements governing the scheme's business strategy. The PPP/PFI redesign process is exhibited in figure 1 as follows:

Insert here Figure 1

According to Aristotelian teleology and its relating ontological axioms, scheme's requirements decomposition (see figure 1: step 1) will produce in a direct and finite way the interactions between the scheme's systems, actors and environment, based on specific requirements that will be designed (see figure 1: step 2 &3). The ontology of the scheme's internal and external environment will conceptualise and synthesise the intrinsic and extrinsic system values of the Using System (US) actors according to contemporary business approaches (see figure 1: step 3 &4). Therefore, these axioms will form the scheme's structure with the contemporary business approaches and ethics (see figure 1: step 5) as governed by "Telos" (the end) (Nagel, 2012). The above ontological properties will be axiomatically analysed in the next section (2.2) following the PPP/PFI Redesign Process (see figure 1).

2.2 The Ontological Analysis of the Scheme's Redesign Process

Analysis initiates by decomposing the internal and external business environment of US stakeholders' roles (see figure 1: step 1). The redesign will introduce four ontological axioms that will be used to analyse the scheme's structure relating to: environmental parameters (e.g. internal and external business environment, actor's decision-making, system's composition, structure); systems (e.g. social, conceptual, and technical) and actors (scheme's stakeholders, e.g. government, banks, consumers).

The first of the four axioms is the operation axiom where system actors (subjects) act with the responsibility for coordination (coordination acts diagrammatically indicated in figures 1 and 2) and their definitions that are required for the PPP scheme's redesign. In coordination and production acts the square indicates that the actors are acting based on their role and according to their span of authority. The embedded circle in coordination acts indicates their responsibility for coordination. In production acts actors produce their service. The embedded diamond signifies their managerial competence for the production act with a

SMART based result (Yemm, 2013). The PPP strategic goals and objectives will be referred as system facts once they are accomplished.

The second axiom is the transaction axiom where system actors (subjects) perform transactions based on their relative stake towards the design and implementation of the collaboration scheme. Thus, actors coordinate, based on the first axiom (Performance in Social Interaction axiom, or PSI axiom), ordering (e.g. stakeholder 1) for a service (e.g. the formation of a PPP). Other actors execute (e.g. stakeholder 3 or 6) the ordered service resulting to a production act (e.g. the PPP contract).

The third axiom is the composition axiom that analyses the quality of the contract components (e.g. necessary annexes and other documents attached to the contract). It forms the successful transaction resulting to a PPP contract that is now considered a system fact. This fact is now present among system actors and produces stakeholder 2 (Special Purpose Vehicle, or SPV).

The last axiom is the distinction axiom, which clearly distinct the stakeholders' role based on the PPP scheme. Each role is produced based on actor's ability to communicate as a performer and thus taking decisions, or as an informer by expressing expertise, or as a former by perceiving documentation.

Comprehending the US design and the stakeholders' composition and distinct roles is an important step for the selected redesign methodology (see figure 1). Based on the ontological axioms, the US will be analysed and strategically assign, based on Language Action Principles (LAP) (Habermas, 1981), the stakeholders' distinct roles and operations (see figure 1, step 1). Based on this step (figure 1, step 1) the US implementation abstracts from the ontological level of PPP understanding which will be gradually introduced, once missing requirements based on CSFs of the US (figure 1, step 2) are identified at the Object System (OS) initiation (figure 1, step 3). Further conceptualisation and synthesis of the OS will lead the system redesign (figure 1, step 4 & 5) until its final construction and implementation based on KPIs (figure 1, step 5).

The proposed redesigned methodology, which is initiated at step one, will distinctively decompose the US knowledge. It will be based on the ontological axiom of distinction, which is necessary for the comprehension of the actors' decision-making process of the US.

Step 1: PPP Using System (US) Decomposition based on Ontology

The proposed redesigning starts with the ontological decomposition and analysis of the current PPP/PFI business design (step 1). The US design highlights the scheme's actor roles and

designates their business strategy (see figure 2). The main objective at this step is the US composition according to the distinction axiom and PSI theory of enterprise ontology (Dietz, 2006). The US composition of actors and their role to the scheme is based on seven stakeholders. Stakeholder 1 is the government which most of the times holds the assets of the project. It provides the long-term use of the assets (e.g. 25-35 years) through the collaboration contract. Stakeholder 2 is the Special Purpose Vehicle (SPV). The SPV is the system's kernel. It is a legal entity created primarily for the purpose of the project's management and operation and its life span coincides with the one of the project. It is responsible depending from the PPP/PFI scheme for the Design, Building and Financing (DBF) or for the Design Building and Operation (DBO) of the services delivery to the governmental stakeholder, ensuring the project's contractual strategy. Usually, the SPV uses public infrastructure until the project ends. Stakeholder 3 are the project experts. They are usually services oriented and receive contract for delivering the knowledge into the project's management and operation. Stakeholder 4 is the project's shareholders. Most of the times are legal entities, which provided equity to the project. Stakeholder 5 are the consumers of the project (public or private). Stakeholder 6 is the escrow agent. The agent is usually responsible for the property and coordinates the examination of all legal and economical documentation relating to the income and expenses of the project. Stakeholder 7 are the banks. Most of the times they provide capital through long-term debt agreements.

In the US design all project actors, based on distinction axiom, are forming three major strategic categories according to their operation roles. The first category includes the internal environment's communication of the actors. The second category includes the external environment's communication of the actors. The third category is the product of their communications (internal and external). It expresses the social world and its related documentation interaction that will form the strategy of the SPV, giving birth to the project's US design. The US actors' communication roles are conceptualised based on their competence and responsibility. They are dichotomised as objective or subjective and they operationally interface with the scheme's kernel. The kernel will lead their acts which if successfully turned in to facts then the strategic objectives of the SPV could be formed.

One category of actors, coloured in green, includes private or public entities, which have their own distinct role in the scheme. They are coordinating with informing transactions producing the US structural design. Their role, which is not directly influenced by the system's kernel form, will be conceptualised as objective. The actors will cooperate by formulating and educating

scheme's formal structure. Moreover, this category of external actors with primarily objective roles is now coloured in green (see figure 2). This category includes stakeholders 6, 7 and 5. Stakeholder 6 is the escrow agency. The agency's communication role is considered objective as it coordinates information relating to the legal and economical documentation produced. This project actor is an external one as it preserves its own district role with or without the SPV formation.

Stakeholder 7 are the banks. They have an objective communication role performing financing transactions for the economic viability of the scheme. They also have their own district role regardless of the SPV formation. Stakeholder 5 are the consumers. They are, besides their importance, also considered external. Their role is irrelevant to the potential implementation requirements of the PPP scheme. It is assumed that these requirements are objectively communicated and comprehended from their democratically elected government actor.

Another category is the performa one, coloured in red, where all internal actors are included. The actors included have a direct interest to the SPV formation. They will have a unique role in the scheme's composition, which will depend from the business strategy governing the US collaboration. This strategy is expressed primarily through written documentation (e.g. tariff payments, KH) and is directly relevant to the US scheme's contract. They have their own distinct role in the model structure, which is a priori subjective due to the unique SPV formation of each PPP/PFI scheme (Liu and Wilkinson, 2014). Thus, the fundamental challenge of a successful and objective decision-making is led by the individual strategic perceptions of these internal actors. They will expose commitment (e.g. shareholders) or evoke commitment (e.g. government) leading the formation of the SPV. These actors are 1, 3 and 4.

Stakeholder 1 is the government. The government's communication role is considered subjective. It represents its political agenda based on which it conceptualises these collaboration schemes. It aims to secure its role towards the legal and economical documentation produced (e.g. risk transfer). Its responsibility includes a contract production. This project actor perceived as an internal one. It preserves its own district role, based on its fundamental production act that of the contract.

Stakeholder 3 are the project experts. The expert's communication role is also considered subjective. Their role's activity, as denoted in figure 2, is an executorial one and thus it should be evaluated accordingly. They have to produce a KH service for the project. The performance methodology used by this actor hardly embeds necessary changes deriving from valuable

Know-How (KH) services transferred from previous empirical evidence. Thus, the unique dynamics behind the changing governmental strategy of social, economic and political environment define largely the methodology adopted by experts and not vice versa. Once the scheme's KH learning process is adapted, it will be used to prioritise the strategic regeneration of the US. Then strategic alliances will stop lacking alliance strategies (Trafford and Proctor, 2006). Thus, the role of this actor is subjective and finite.

Stakeholder 4 are the shareholders. The shareholder's communication role is also subjective depending from the contractual interrelation of each actor. Internal actors aim to secure the projects viability position towards the legal and economical documentation produced (e.g. risk transfer and KH). This actor is an internal one, within the SPV kernel. It preserves its own distinct role upon the implementation of the SPV. This category of internal players like the government, project experts and shareholders is coloured in red (see figure 2).

The last category, coloured in blue, contains the necessary PPP information documents leading the strategic alliances among the US external and internal environment actors (see figure 2). It is an essential category as it could analyse the intrinsic and extrinsic actor values (e.g. financial, marketing, innovation and learning issues analysed in the contract validities) of a successful PPP design. These documents are also uttering strategic information in writing (e.g. contracts) to be stored and evaluated SMART.

Insert here Figure 2

This initial step presents the current situation (US) of the actors participating in the US design according to enterprise ontological properties and distinction axiom. Thus, their social interaction and their related environments (external or internal) could now be ontologically conceptualised based on their roles (subjective or objective) and their relating performance (based on intrinsic or extrinsic or intrinsic values). The dichotomy implemented, at this step, between subjects and objects and their business interaction will assist to the following methodology steps towards an objective PPP redesign. Step 2 (see figure 1) will determine the missing US requirements relating them to performance of intrinsic and extrinsic stakeholder's values aiming towards a novel conceptualisation at step 3.

Step 2: Determine PPP Missing Requirements

In step 2, the determination of the US missing requirements is in order. At this step, focus is placed on the missing system requirements according to enterprise ontology. In the US many problems arise due to lack of system's specification parameters. The presence of such requirements should be emphasised from the first phase of the project, the bid phase. At this phase, evaluation criteria, methodology and measurability for assessing future KPIs should be objectively designed (Lam et al., 2010). Objectivity is a missing parameter to many contemporary PPP projects resulting to poor operational design and implementation (Xu et al, 2020). Thus the fundamental value of the PPP/PFI contract, which the sum of its intrinsic and extrinsic values, requires an objective strategic conceptualisation (methodology step 3).

According to the problem's historic background there are many cases, especially on the NHS (Mayston, 1999), where hospital PPP/PFI schemes show VfM only after risk-transfer. According to this innovative ontological approach, all stakeholders should be engaged to the design process. This phase should determine the missing requirements for a successful strategy (e.g. CSFs) taking into consideration objective and subjective perceptions of all environmental factors analysed at methodology step 1.

Aligning their performance, information and form knowledge activities relates the PPP/PFI contract risk (extrinsic contract value) with the VfM (intrinsic contract risk). Therefore, the scheme performs KPIs once the intrinsic value of the contract (VfM) is aligned with its extrinsic value. As a result, it underlies the necessity of bridging the conceptual gaps. According to literature review, conceptual gaps are the missing requirements among VfM, CSFs and KPIs and they should be visualised to the novel redesign. According to Osei-Kyei et al. (2017), upgraded consultation and design visualisation would improve the problem of poor design. Although, this conceptual gap of opaque visualisation is not a new one. According to figure 2, this type of risk is persisting in the US design. It is discovered between the SPV and the escrow agent. It is an important gap as the result of the contracting process more than triples the cost of capital. Specifically, it raises it from 8% to 27%, as a percentage of trust's annual operating income managed by the escrow agent (Pollock et al, 2002). Following that US conceptual gap, banks (Stakeholder 7) through bank payments are profiting more from the scheme and local government stakeholders are struggling to survive. These external and internal actors' empirical cases will determine the missing requirements of the US. In addition, the redesign of an OS should carefully consider these conceptualisation gaps and synthesise the collaboration scheme's concepts of intrinsic and extrinsic values.

Evidence shows that project experts (stakeholder 3) are closely monitoring this process. They are although unable, due to their finite roles (see step 1), to define subjectively maximum

achievable outcome based on KPIs. Maximum achievable outcome is defined as the best VfM service (Zhang, 2005). Problems initiate from the initiation phase due to subjective definition of the project's strategic objectives and their poor evaluation schemes (Zhang, 2005). Thus, the interrelation and communication of all the project's stakeholders is becoming difficult due to the conceptual gaps and expected facts occurring among the different types of stakeholders' knowledge activities. The conceptual gaps emerge discrepancies in the US design requirements and their relating actor's interactions, which are composed of: i) quality costs (intrinsic value linking to KPIs and VfM); ii) time frames (intrinsic value linking to KPIs and VfM); iii) coordination acts (extrinsic value linking to CSFs and risk); and iv) communication services (extrinsic value linking to CSFs and risk).

These discrepancies jeopardise the strategies designed for the project's value added and the performance level achieved (Jingfeng et al, 2009). The discrepancies of the strategic objectives relate to contract's intrinsic and extrinsic values the US KPIs are failing to capture VfM services thresholds relating to CSFs (e.g. budgets constraints, risks and revenues) (Larhsoukanh & Wang, 2019). Divergent conception of the collaboration scheme and its strategic objectives from stakeholders initiates strategic conflicts (De Schepper et al, 2014). The ultimate recipients of these conflicts are the consumers (stakeholder 5) as they are not receiving a VfM service.

Concluding, the above missing requirements are identified at this step for OS redesign and ontological conceptualization. They are the extrinsic and intrinsic contract values and their relation to CSFs, which link to VFM services and their relating KPIs. The next step is the OS system function and conceptualisation, which should take into consideration all the missing requirements identified at this step. The OS design should consider KPIs based on a novel PPP objective conceptualisation, which takes into account the scheme's CSFs. It delivers an integrated design that formalises all organisational requirements. The novel system's feasibility will be demonstrated by the design of conceptual framework prototype (OS) that follows.

Step 3. Identify Object System (OS) Function Requirements

At this methodology step (see figure 1, step 3) an identification of the OS requirements is critical, as they will guide the redesign process for the following steps. The organisational

theorem of DEMO provides a holistic and distinct essence of the US organisational conceptualisation (see figure 2) based on its composition, production and environment supporting the overall goal of the PSI and the ontological axioms presented at previous methodology steps (figure 1, step1&2) (De Jong and Dietz, 2010). So, before the OS is conceptualised (see figure 1, step 4) an identification of the prominent functional requirements for the OS based on the US missing requirements is important. Based on dichotomy principle introduced (see figure 2 step 1) the actors according to their roles (objective or subjective) are performing acts (performa, informa and forma) in order to meet the contract strategy and values. According to this axiom the schemes stakeholders possess three distinct human abilities critical to the system's design specification as they lead to various operative actions. The performa ability exposes a commitment leading to business decisions (ontological action), the informa ability formulates a thought leading to reasoning (infological action) and the forma ability that perceives information leading to storing actions (forma action). Based on this ontological distinction axiom the above figure is now transformed accordingly (see figure 3).

Insert here Figure 3

The main goal at this step is to describe and conceptualise the PPP scheme according to the distinction axiom and compare it with the current communication scheme. The designing tool of ontological parallelogram denotes the PPP conceptualisation (see figure 4). In this conceptual framework, the objective sign of a successful collaboration strategy is adopted for representing the scheme. This successful sign designates the concept that is a subjective individual mental picture of the aim. It simultaneously denotes its objective properties, which are stated by selected CSFs. The type of PPP/PFI collaboration agreements extends to a class of KPIs. These KPIs could populate selected CSFs. Thus, the object of CSFs could conform to the PPP/PFI agreements. The PPP aim is referenced by the CSFs underlying an objective bridging of current conceptual gaps. The ontological parallelogram exhibits how PPP/PFIs could be successfully conceptualised to global organisational actors, regardless of their sociocultural background.

Insert here Figure 4

In conclusion, to complete the conceptualisation of the OS the three major sets of conceptual parameters missing at this methodology step are presented. Firstly is the PPP objectives' implementation, which requires alignment and trust. For years, mistrust and hostility between some or all of the partners is present most of the times (Bennett et al, 1998). The conceptualisation and its objectives' design (see figure 4), eliminates generalisations that lack specificity. It provides fertile ground for methodological parametrisation, as it eliminates the obscurity of multiple and contradicting concepts, which build tension between autonomy and accountability (Huxham and Vangen, 2000). DEMO and enterprise ontology are monitoring such conceptual gaps, as demonstrated by figure 2 and 4 in an objective manner. According to Trafford and Proctor (2006) major parameters that should be included to such an objective focused design are: Communication, Openness, Planning, Ethos and Direction (COPED) all of which are present to Language Action Principles (LAP) embedded in the enterprise ontology (Dietz, 2006).

The second conceptual parameters missing is the objectives' performance and control. This parameter most of the times possess a major disappointment for PPP evaluation as key performance indicators usually are directly related from the parameters presented in the previous missing list of requirements described as COPED. Therefore, a framework of five KPI-categories in the areas of physical characteristics of the project, financing and marketing indicators, innovation and learning, stakeholders' indicators and process indicators should be present to cover potential conceptual gaps (Jingfeng et al, 2009). These indicators should be present from the bidding until monitoring and controlling processes of the product for both public and private stakeholders (Kumaraswamy and Anvuur, 2008). The CSF should be carefully selected, based on the conceptual framework (see figure 4), for the performance evaluation of the scheme. Performance transparency and objectivity versus subjectivity should be considered to a successful controlling process.

The third conceptual parameters missing is the objectives flexibility. Most unsuccessful PPP projects' objectives are static. They lack adaptability throughout the project's lifecycle in relation to social and economic parameters. Most of the times PPPs initiate under different external environmental parameters. Over their long contracting lifecycle, these parameters change and stakeholders fail to cope, making the scheme's objectives obsolete (Abdel, 2007).

Consequently, an innovative approach in relation to traditional public or private business scheme construction requires a dynamic monitoring and parametrisation of the CSFs for achieving a successful design.

3. Conclusions and research outlook

This paper methodologically provides a novel, transparent and globally sustainable conceptual design. It addresses complex and diverse empirical evidence on PPP/PFI business collaboration strategies, which although possess different sociocultural and economic dimensions, they are not exclusively distinct. According to enterprise ontology application and its related methodology DEMO, this study provides a global, dynamic and objectively supported and comprehensive design, addressing the ongoing PPP structural failures.

The findings of this study address a plethora of general and non-critical arguments with respect to the design of PPP/PFIs rooting. These arguments are sourced from: i) the lack of actors' coordination and responsibility resulting into conflicts (Casady et al, 2018; Girth, 2014), ii) scepticism with respect to its aim and objectives (Liu and Wilkinson, 2014), and iii) lack of commitment and transparent governance (Osei-Kyei et al, 2017). It catalytically therapises its design to overcome problematic economic viability arising from lack of trust and reluctance for cooperating with incohesive sociocultural practices. Enterprise ontology's organisational theorem and the ontological parallelogram (see figure 4) objectively support the aim of the contract agreement, improving heterogeneous multilevel management. As a result, they resolve potential conflicts among collaborating actors (Wang et al, 2020; Marques and Cruz, 2013).

This business organisational design ontologically delivers an increased efficiency over measurable quality services, which could be supported from critical successful acts, defined as facts. At information and data level, these facts are providing equal information access to all decision-makers. The organisational theorem categorises bilateral communication stakeholders' roles and homogeneously spans their managerial control. The ontological parallelogram designates successful strategies based on a transparent design that objectively conceptualises the value added aim and objectives.

Furthermore, international accounting processes (e.g. costing and budgeting) could measure critical successful facts, which objectively conform to the PFI type as an instantiation of the PPP collaboration concept. Accordingly, these ontologically based transactions could enable activity-based costing, budgeting and monitoring, facilitating the financial sustainability of the project. Cost drivers could be assigned to each LAP-oriented activity, as schematically conceived by the ontological parallelogram, enabling novel strategies for improved risk allocation delivery of public infrastructure and capped lifecycle expenditures aiming at VfM

services (Regan et al, 2011). According to Jiang et al. (2018), this combination of ontological modeling techniques and PPP-based risk analysis methods efficiently deals with the complexity in organisational storage and re-use of risk information.

The scheme's ontological operation facilitates project's economic evaluation activities with the adoption of Generally Accepted Accounting Principles (GAAP), creating necessary lifecycle costing at all phases of the project (Brown et al, 2017). Thus, the findings of this study reveal a consistent design providing fertile ground for future research on PPP models in terms of methodology and successful design conceptualisation. It eliminates trivial results, arising from literature generalities. It also epistemologically unfolds the strategic comparative advantage and value added of successful PPP/PFIs concepts. Therefore, on the one hand, this ontological approach leads to an innovative global view of the international principles regarding successful PPP/PFI schemes. On the other hand, there are certain design limitations relating to: i) kernel's analysis and evaluation; ii) unanimity on the scheme's strategic objectives; and iii) conceptual framework application and activity control.

A successfully designed PPP/PFI could attract local and international investment partnerships, as it conceives innovative and technological activities due to its semantic objectivity (Kamsu-Foguem et al, 2019). It also critically improves the sociocultural infrastructure and provides a mutually inclusive and holistic partnership. This study also contributes to the engineering of successful PPPs by demonstrating how its holistic conceptualisation is hierarchically disseminating among collaborating actors. A successfully designed PPP/PFI could also address core problematic issues regarding informational democracy for equal access to decision-making between public and private actors, qualifying for highly impactful global involvement partnerships.

Finally, this study could motivate a further systematic examination of ontologically empowered activity functions in the collaborating policies, processes and transactions. Further analysis could reveal the potential impact of the proposed design on the long-term viability of PPP/PFIs. This framework could be also considered as an international toolbox for OECD policy makers, upgrading the social profile of PPP/PFIs by actively engaging consumers to inform successful business level strategies.

References

- Abdel Aziz, A. M. (2007). "Successful delivery of public-private partnerships for infrastructure development", *Journal of construction engineering and management*, Vol. 133, No. 12, pp. 918-931.
- Beck, M. (2009). *Policy, finance & management for public-private partnerships*. A. Akintoye (Ed.). Wiley-Blackwell. West Sussex, UK:
- Ameyaw, E. E., & Chan, A. P. (2013). Identifying public-private partnership (PPP) risks in managing water supply projects in Ghana. *Journal of Facilities Management*.
- Barlow, J. and Koberle-Gaiser, M. (2008), "The Private Finance Initiative, project and design innovation: The UK's Hospital Programme", *Research Policy*, Vol. 37 No. 8, pp.1392-1402.
- Bennett, J. and Jayes, S. (1998), *The Seven Pillars of Partnering: A Guide to second Generation Partnering*, Tomas Telford, London.
- Boyer, E. J. (2016). Identifying a knowledge management approach for public-private partnerships. *Public Performance & Management Review*, 40(1), 158-180.
- Brown, A., Fishenden, J., Thompson, M., & Venters, W. (2017). "Appraising the impact and role of platform models and Government as a Platform (GaaP) in UK Government public service reform: Towards a Platform Assessment Framework (PAF)." *Government Information Quarterly*, Vol.34, No.2, pp. 167-182.
- Casady, C., Eriksson, K., Levitt, R.E. and Scott, W.R. (2018). Examining the state of public-private partnership (PPP) institutionalization in the United States. *The Engineering Project Organization Journal* (December 2018) Volume, 8.
- Chen, K., Xu, X., Yuan, F., Yuan, J., & Li, Q. (2017). Developing an ontology-based knowledge base for residual value risks in PPP projects. In *Proceedings of the 20th International Symposium on Advancement of Construction Management and Real Estate* (pp. 1293-1305). Springer, Singapore.
- Chou, T. H., Vassar, J. A., & Lin, B. (2008). "Knowledge management via ontology development in accounting", *Kybernetes*, Vol. 37, No.1, pp. 36-48.
- Cui, C., Liu, Y., Hope, A., & Wang, J. (2018). Review of studies on the public-private partnerships (PPP) for infrastructure projects. *International Journal of Project Management*, 36(5), 773-794.
- De Jong, J., & Dietz, J. L. (2010, June). Understanding the realization of organizations. In *International Workshop on Cooperation and Interoperability, Architecture and Ontology* (pp. 31-49). Springer, Berlin, Heidelberg.
- De Schepper, S., Doms, M., & Haezendonck, E. (2014). "Stakeholder dynamics and responsibilities in Public-Private Partnerships: A mixed experience". *International Journal of Project Management*, Vol.32, No.7, pp. 1210-1222.
- Dewulf, G., & Garvin, M. J. (2020). Responsive governance in PPP projects to manage uncertainty. *Construction Management and Economics*, 38(4), 383-397.
- Dietz, J.L.G. (2006). *Enterprise Ontology*. Germany Springer-Verlag, Heidelberg
- Eadie, R., Millar, P., Grant, R. (2013), "PFI/PPP, private sector perspectives of UK transport and healthcare", *Built Environment Project and Asset Management*, Vol. 3 No. 1, pp.89-104.
- Effah E.A. and Chan P.C.A. (2013), "Identifying public-private partnerships (PPP) risks in managing water supply projects in Ghana", *Journal Of Facilities Management*, Vol. 11 No. 2, pp. 152-182.
- Fewings, P., & Henjewe, C. (2019). *Construction project management: an integrated approach*. Routledge, London.
- Garg, S., & Garg, S. (2017). Rethinking public-private partnerships: An unbundling approach. *Transportation Research Procedia*, 25, 3789-3807.

- Gupta, R., et al. (2002). "Increasing transparency in partnerships for health-Introducing the Green Light Committee." *Tropical Medicine & International Health*, Vol. 7, No. 11, pp. 950-960.
- Habermas, J. (1981), *Theorie des Kommunikatives Handelns, Erster Band*, Suhrkamp Verlag, Frankfurt am Main.
- Huxham, C., & Vangen, S. (2000). "Ambiguity, complexity and dynamics in the membership of collaboration", *Human relations*, Vol. 53, No.6, pp.771-806.
- Holden, C. (2009). "Exporting public-private partnerships in healthcare: export strategy and policy transfer". *Policy Studies*, Vol. 30, No. 3, pp. 313-332.
- Jingfeng, Y. et al. (2009), "Selection of performance objectives and key performance indicators in public-private partnership projects to achieve value for money", *Construction Management and Economics*, Vol 27, pp.253-270.
- Jiang, X. Y., Wang, M. H., Tian, H. K., YU, H., & HU, K. (2018). Ontology based semantic modelling and retrieval for the risk information of PPP projects. *Journal of Civil Engineering and Management*, 1(011).
- Jugdev, K., & Müller, R. (2005). "A retrospective look at our evolving understanding of project success". *Project management journal*, Vol.36, No.4, pp. 19-31.
- Kamsu-Foguem, B., Abanda, F. H., Doumbouya, M. B., & Tchouanguem, J. F. (2019). Graph-based ontology reasoning for formal verification of BREEAM rules. *Cognitive Systems Research*, 55, 14-33.
- Koopmann, P. (2019, July). Ontology-based query answering for probabilistic temporal data. In *Proceedings of the AAAI Conference on Artificial Intelligence* (Vol. 33, pp. 2903-2910).
- Koppenjan, J.F.M. (2005), "The formation of public-private partnerships: lessons from nine transportation infrastructure projects in Netherlands", *Public Administration*, Vol. 83, No.1, pp.135-57
- KPMG (2010), "Delivering value for money through infrastructural change", available at: <https://www.excellencegateway.org.uk/content/import-pdf16723-0> (accessed 02 December 2020).
- Kumaraswamy, M.M. and Anvuur, A.M. (2008), "Selecting sustainable teams for PPP projects", *Building and Environment*, Vol.43, No.6, pp.999-1009
- Lam, P. T. I., Chan, A. P. C., & Chan, S. H. (2010). A best practice framework of output specifications for PPP projects. In *TG72-Special Track 18th CIB World Building Congress May 2010 Salford, United Kingdom* (p. 54).
- Larhsoukanh, S., & Wang, C. (2019). "Determining optimal meeting frequency: a bargaining solution to improve a poorly functioning PPP industry under budget constraints", *Economic research-Ekonomska istraživanja*, Vol. 32, No. 1, pp. 2568-2583.
- Liu, T., Wilkinson, S. (2014), "Large-scale public venue development and the application of Public-Private Partnerships (PPPs)", *International Journal of Project Management*; Vol. 32, No.1, pp.88-100.
- Lonsdale, C. (2005). 'Post-Contractual Lock-In and The UK Private Finance Initiative (PFI): The Cases of National Savings and Investment and the Lord Chancellor's Department', *Public Administration*, Vol.83, No.1, pp. 67-87.
- Mayston, D. J. (1999). "The private finance initiative in the national health service: an unhealthy development in new public management?". *Financial Accountability & Management*, No.15, Vol.3-4, pp. 249-274.
- Microlinks (2009) available at: https://www.agrilinks.org/sites/default/files/resource/files/FTF_FEEDBACK_Value_Chains_Theme_Lit%20Review.pdf (accessed 02 December 2020).

Nagel, T. (2012). *Mind and cosmos: why the materialist neo-Darwinian conception of nature is almost certainly false*. Oxford University Press, Oxford.

OECD. (2008) Public–Private Partnerships: In Pursuit of Risk Sharing and Value for Money, Public Governance and Territorial Development Directorate Public Governance Committee, Paris: OECD Publishing.

Omobowale, E. B., Kuziw, M., Naylor, M. T., Daar, A. S., & Singer, P. A. (2010). “Addressing conflicts of interest in Public Private Partnerships.”, *BMC international health and human rights*, Vol.10 No.1, pp. 19.

Osei-Kyei, R., Chan, A.P. and Ameyaw, E.E. (2017). A fuzzy synthetic evaluation analysis of operational management critical success factors for public-private partnership infrastructure projects. *Benchmarking: An International Journal*.

Oteng-Adjei, J. (2012), “Catalysing growth and empowering change”, paper presented at the Minister of Energy at the European Union Sustainable Energy for All Summit, 6th of April.

Pantelias, A., and Zhang, Z. (2010), “Methodological framework for evaluation of financial viability of public-private partnerships: investment risk approach”, *Journal of Infrastructure Systems*, Vol.16, No.4, pp. 241-250.

Pitman, P., and Holve, E. (2009) “The health services researcher of 2020: A summit to assess the field’s workforce needs,” *Health Services Resources*, Vol. 44, No.6, pp. 2198-2213.

Pollock, A., Shaoul, J., Vickers N. (2002), “Private finance and “value for money” in NHS hospitals: a policy in search of a rationale?”, *British Medical Journal*, Vol 324, pp.1205-1209.

Raoa, L., Mansinghb, G., Osei-Brysonc, K. (2012), “Building ontology based knowledge maps to assist business process re-engineering” *Decision Support Systems*, Vol.52, No.3, pp. 577–589

Regan, M., Smith, J., & Love, P. (2009). Public private Partnerships: What does the future hold. In *The Construction and Building Research Conference (COBRA 2009) of the Royal Institution of Chartered Surveyors (RICS)* (pp. 462-474).

Regan, M., Smith, J., & Love, P. (2011). Infrastructure procurement: learning from private–public partnership experiences ‘down under’. *Environment and planning C: Government and policy*, Vol.29, No.2, pp. 363-378.

Ren, G., Li, H., Ding, R., Zhang, J., Boje, C., & Zhang, W. (2019). Developing an information exchange scheme concerning value for money assessment in Public-Private Partnerships. *Journal of Building Engineering*, 25, 100828.

Shaoul, J., Stafford, A., & Stapleton, P. (2006). “Highway robbery? A financial analysis of design, build, finance and operate (DBFO) in UK roads.”, *Transport Reviews*, Vol.26 No.3, pp. 257-274.

Steinmetz, C., Schroeder, G., dos Santos Roque, A., Pereira, C. E., Wagner, C., Saalman, P., & Hellingrath, B. (2017, July). Ontology-driven IoT code generation for FIWARE. In 2017 IEEE 15th International Conference on Industrial Informatics (INDIN) (pp. 38-43). IEEE.

Thompson, D. F. (1993). “Understanding financial conflicts of interest”, *New England journal of medicine*, Vol.329, pp. 573-573.

Thomson S., Foubister T., Mossialos E. (2009). Financing health care in the European Union—challenges and policy responses. *European Observatory on Health Systems and Policies Series 17*:1-224. WHO, Geneva.

Trafford, S., Proctor, T. (2006), “Successful joint venture partnerships: public -private partnerships”, *International Journal of Public Sector Management*, Vol. 19 No. 2, pp.117-129.

Tsoukas, H., & Vladimirov, E. (2000). *On organizational knowledge and its management: an ethnographic investigation*. Dept. of Accounting, Finance and Management, University of Essex.

Villani, E., Greco, L., & Phillips, N. (2017). Understanding value creation in public - private partnerships: A comparative case study. *Journal of Management Studies*, 54(6), 876-905.

Von Rosing, M., & von Scheel, H. (2016). Using the business ontology to develop enterprise standards. *International Journal of Conceptual Structures and Smart Applications (IJCSSA)*, Vol.4, No. 1, pp. 48-70.

Wang, Y., Liu, J., Gao, R. and Hwang, B.G. (2020). Government subsidies in public-private partnership projects based on altruistic theory. *International Journal of Strategic Property Management*, 24(3), pp.153-164.

Xu, Z., Wang, X., Xiao, Y., & Yuan, J. (2020). Modeling and performance evaluation of PPP projects utilizing IFC extension and enhanced matter-element method. *Engineering, Construction and Architectural Management*.

Yemm, G. (2013). *Essential Guide to Leading your Team: How to Set Goals, Measure Performance and Reward Talent*. Pearson Edition. pp.37-38.

Yolles, M. (2004). Implications for Beer's ontological system/metastem dichotomy. *Kybernetes*, Vol.33 No.3/4, pp.726-764

Yuan, J., Li, X., Chen, K., & Skibniewski, M. J. (2018). "Modelling residual value risk through ontology to address vulnerability of PPP project system". *Advanced Engineering Informatics*, Vol.38, pp. 776-793.

Zangeneh, P., & McCabe, B. (2020). Ontology-based knowledge representation for industrial megaprojects analytics using linked data and the semantic web. *Advanced Engineering Informatics*, 46, 101164.

Zhang, X. (2005), "Criteria for Selecting the Private-Sector Partner in Public-Private Partnerships", *Journal of Construction Engineering and Management*, Vol. 131, No. 6, pp.631-643.

Zhu, H., Li, J., Gao, J., & Lu, W. (2017). "Research on integrated product service system driven by customer value based on ontology technology", *Kybernetes*. Vol.46, No. 6, pp. 1039-1061.