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DEVELOPMENT OF THE “WATER-SPECIFIC P3 RISK MODEL”, RISKS IDENTIFIED

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ABSTRACT

Risk assessment is one of the key success factors of public-private partnerships (PPP) water projects. Factors such as utility condition problems, unsustainable increase in water supply requirements, socio-technical issues and changes in government policies can cause such capital intensive projects to overrun planned budget and schedule allocations. Where the project is a commercial asset, delayed completion time and cost overruns usually have significant impact on the profitability of the project as well as the estimated returns on investment over the operational phase of the project. Understanding the specific risks involved in PPP water projects can be very crucial in designing containment measures to deal with their likely impact on the projects. Through review of literature and non-participant observation, different risk factors in PPP water projects can be identified. The identified factors can then be rated and prioritised through questionnaires using the Analytical Network Process (ANP) to demonstrate the complex interactions among those risks and to establish the most salient Value-for-Money (VFM) variables on PPP water projects. The outcome of the proposed research is an innovative ANP-based model known as “Water-Specific P3 Risk Model” that offers a platform to incorporate tangible and intangible risk variables into a risk assessment process in water infrastructure projects.

This paper presents the overall research methodology and the literature review undertaken for the identification of the risk factors associated with Water PPP Projects. Subsequent stages of the research is currently under progress.

Keywords: Public-Private Partnerships, Water Infrastructure, PPP Water Projects, Risk Assessment, Value for Money, Analytic Network Process.

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BACKGROUND

In the early 1990s, market-driven approaches for water resources management started to gain acceptance. Water was recognized as an economic good i.e. a commodity that should be priced at its cost of provision and its true value to society (Ouyahia, 2006). For developed countries, the United Nations in its 2000 Millennium Declaration, set eight goals for development, called the Millennium Development Goals (MDGs). These goals set an ambitious agenda for improving the human condition by 2015. In support of these goals, the Millennium Project was launched to recommend the best strategies for achieving the MDGs. Privatization and decentralization have become the main reform policies of the major international organizations (World Bank, International Monetary Fund, Organization for Economic Cooperation and Development). Public-Private Partnerships (abbreviated as PPP, or P3) have been introduced as the most common scheme of project development.

The involvement of the private sector in water infrastructure projects is a subject of much debate, which is currently far from being settled. Statistically, water projects undertaken under private sector are experiencing cancellation/distress at a much higher rate than other infrastructure projects under the same procurement scheme. Both proponents and opponents of water privatization support their claims with figures that should strengthen each party's argument. However, in lack of a common base of comparative analysis, these numbers were not indicative and could be considered as outliers.

The case was clearly summarized by Karen Bakker (2010):

“Most of the debate has centered on the relative merits of the public and private sector in managing large-scale reticulated water-supply networks. Unbiased research is rare; an examination of comparative performance is often influenced by ideological commitments. It is thus somewhat predictable that proponents and opponents of water privatization rarely agree on research strategies.”

RESEARCH METHODOLOGY

A research on Water PPP is not expected to conclude on the debate on this matter. However, a better understanding of the risks involved in water PPP projects can significantly assist in designing containment measures to deal with their likely impact on the projects.

In order to achieve this aim, a research plan was set which comprises of identifying the risks associated with water PPP projects through the review of literature. The identified factors can then be rated and prioritized through questionnaires and non-participant observation utilizing the Analytical Network Process (ANP) to demonstrate the complex interactions among those risks and to establish the most salient Value-for-Money (VFM) variables on PPP water projects. The outcome of this research will be an innovative ANP-based model known as “Water-Specific P3 Risk Model” that offers a platform to incorporate tangible and intangible risk variables into a risk assessment process in water infrastructure projects.

CRITICAL REVIEW OF LITERATURE

This stage was considered necessary as a primary stage prior to identifying of risks in water PPP projects through a subsequent stage of literature review. The aim of this primary stage was to better understand the ongoing debate on this matter, and for getting a comprehensive grasp of existing knowledge that would allow making an original contribution to knowledge in this research area as advised by Naoum (1998). The

research included investigating the various disciplines related to water infrastructure including construction, rehabilitation, asset management, and financing.

Proponents and Opponents of Water Privatization

Both proponents and opponents of water privatization supported their claims with figures that should strengthen each party's argument. A critical review of the most common assumptions/allegations made by each party is presented in this section.

The proponents of water privatization have always linked the poor political condition in some countries to the deficiency in water supply management especially in third world countries. This is a very general assumption, besides it ignores the fact that the same political bodies are responsible for engaging private sector parties in new water infrastructure projects. Accordingly, the assumption that the mis-management of political parties of water resources would only change if we switch to engaging the private sector is invalid. The assumption that private corporations will endeavour to lower their prices to gain more costumers is not always valid. After a certain point, the increase in water supply may require additional resources (facilities, equipment, services, etc...) to maintain the same level of service, which will result in additional cost to the Private corporation. The claimed success of water PPP projects in some developed countries cannot be considered as a proof of the success of such schemes in every country, especially in developing countries with significantly different conditions. It only proves that a proper setup of such scheme is a necessity of such procurement model. The assumption that poor people are ready to pay more for an improved service does not explain the social and political tension that water privatization face in first world countries like in Canada.

On the operation side, the assumption that the engagement of private sector will action an immediate improvement to the service is not valid. The fact is that water spillage from pipes are mostly attributed to aging infrastructure where available records of previous maintenance activities either does not exist or is not made available. Even with the availability of such records, the rehabilitation/maintenance of water pipes is facing limited budgets allocated for maintenance. The engagement of private sector is not foreseen to change things dramatically in this regard. The assumption that private corporations will have more tendency to handle water with care is not always accurate given that the private sector is engaged in a pre-determined contract value over a certain period of time with a pre-agreed level of performance. The increase of water supply may lead to more effort (and cost) to comply with the stakeholders' requirements and maintain the same quality level. Assuming that private sector will allow for more investment in research and development is not always accurate. A relatively large amount of research is taking place in developing improved strategies for water pipes maintenance and rehabilitation; however, governments mostly fund this research according to our observations.

The assumption that users, under the free water-pricing model, will have the option to seek an alternative in case of improper service is clearly not valid given the monopolistic nature of the water sector. Also, the assumption that private entities will seek an improvement to their service for an increased use and earnings is not always accurate. The additional use of resources can lead to more investments in facilities so as to handle such increase and maintain an acceptable operational/environmental level of service. The proponents typically ignored the necessity of developing a water policy based on available resources and target achievements with respect to water access and quality. The arrangement and coordination of new proposed projects should follow such policy. The allegation made that building major infrastructure facilities like dams is not always a necessity forms an unsubstantiated claim unless the associated engineering studies are

examined. The indication by Segerfeldt (2005) that World Bank on investments on public works like building large dams have lead to many spectacular failures is very general, and is therefore is not acceptable. Building dams, like any other engineering project, should have the typical engineering studies starting from preliminary design till detailed design to allow for a proper assessment, analysis, and execution. Moreover, the reference by Segerfeldt (2005) to a major public works failure like in the Soviet Union that took place during the 1950s does not offer a scientifically acceptable basis for evaluation (P21). Linking a proper water policy to market-driven policies is not valid. In Chile, private ownership was introduced where landowners were given the right to own water and sell it at freely determined prices. The success of such model in Chile does not necessarily guarantee that the same model is valid everywhere as engineering requirements beside political and social conditions should be studied well for each case. In any case, the overall planning of water supply is not expected to be handled by local residents but rather by responsible organizations.

On the other side, the opponents have put most of their efforts opposing the concept. Brubaker (2011) considers that many municipal utilities are ill-equipped to deal with new challenges in the industry and lack the necessary expertise at all levels. In-depth research on the matter is very limited. The most notable effort towards a more rational assessment of the situation was conducted by Bakker (2010). Bakker analysis came from a different starting point of the debate, through focusing on issues of governance, where many are common between public and private parties. However, in our opinion, Bakker generally implied a shared responsibility between the public and private sectors for the current on-going deficiencies in this sector. As an example, while the reported overall market share of private sector is around 3%, Bakker still note that the private sector is handling 20% of the market in urban areas with its current known deficiencies. While this may be true, it ignores the fact that the majority of services at its current conditions is offered by the public sector with its currently known deficiencies.

Declination of the Number of Water PPP Projects

According to World Bank data, a severe drop in the number of water PPP projects has occurred. The number of new projects with private participation that reached financial or contractual closure in 2009 declined by 46% compared to 2008. Annual investment commitments fell by 31% within the same period (Refer to Figure 1 below). Based on the World Bank data, by 2009, the percentage of cancelled/distressed projects in water infrastructure forms 34% of the total committed investment, compared to 8% in electricity, 3% in telecom, and 8% in transport. The subject is not well-addressed in the research as of the reasons for such drop. In general, Ouyahia (2006) presented the water sector specific nature. Several case studies of such failures have been presented but in our opinion, most of this work was driven by the ideological concepts of the authors, or at least limited to the cases in hand. There is a need for an overall assessment of the situation where the reasons for such drop are assessed and delineated by industry experts to a list of risks associated with water sector.

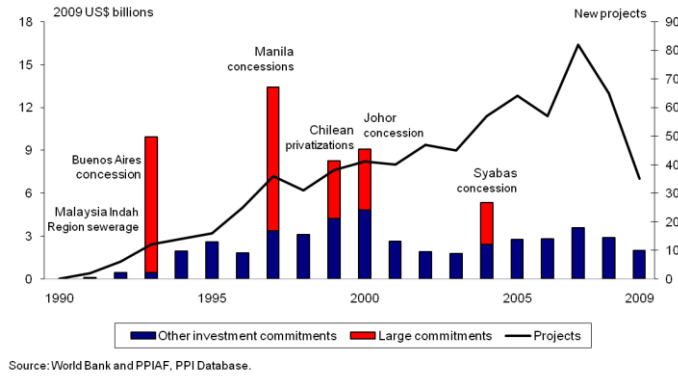


Figure 1: Private Participation in Infrastructure Projects between 1990 and 2009
Source: World Bank and PPIAF, PPP Database (2010)

THE “WATER-SPECIFIC P3 RISK MODEL”, RISKS IDENTIFIED

Considering the knowledge obtained from the primary stage of the literature review, the author conducted an extensive review of water PPP projects cancellation including studying several published case studies. Presented in this section are the water-specific risks identified throughout this review which was found to be the common causes of cancellation of many water PPP projects.

A. Absence of Facility Records

Inadequate performance records for years in the past would prevent having meaningful comparisons between the public operator and its private successors. In Halifax, the disagreements between the public and private parties arose months after the initial agreement was signed. The private party claimed that potential problems with influent quality came to light only when the federal government issued its environmental screening report for the project. Prior to that, it relied on out-of-date data provided by the city and by local industry. Halifax insisted that it provided ample opportunities for testing and that it would have been reasonable for the consortium to do due diligence.

B. Asset Condition

Asset Valuation: Obtaining solid information about the state of infrastructure is significant for a proper project evaluation and risk assessment of new investments. A clear identification of the asset condition is a major technical challenge. Besides, the lack of records of the previous activities relevant to existing systems is very common and does not make the issue any easier. Without such information, it difficult to establish a baseline to enable private firms to accurately bid on the work. This has been constantly a source of disputes. In the case of Atlanta, where some parts of its Infrastructure dates back to 1875, the private partner “Suez” complained that the initial contract as it was signed did not reflect the actual status of the system. The Reason Foundation explained, “Some of the blame must fall on UWSA (Public owner). All of the bidders knew about the lack or quality of data ahead of time before they bid. Furthermore, USWA has a lot of experience running old systems and it should have built that expertise into its proposal.” In the case of Buenos Aires, the unexpected poor performance of the buried assets was one of the reasons that lead to project cancellation at the end. In the case of Hamilton, the municipal staff confirmed that for the Contractor to meet the required performance standards, the system requires investment of hundreds of millions of dollars, which does not form part of the Contractor scope of work. The assessment of infrastructure conditions by requiring several competing firms to study a system extensively would be

inefficient. Producing numerous feasibility studies would push up the costs of the bids and, by making the bidding process too expensive for small firms and will reduce competition. The most basic valuation problem in valuing assets-in-place is the use of discounted cash flow (DCF) techniques (Hertz, 1964). Regardless of the individual strengths and limitations of the various valuation methods, a common deficiency is that there is no indication of the confidence level on the determined capitalization rates (Ye and Tiong, 2000). The Asian Development Bank guidelines (1999) provides recommended financial evaluation methodologies for water supply projects.

Asset Management: Significant research has been conducted on the rehabilitation of distribution networks. The traditional strategies for rehabilitation varies between: Operative, inspection, Condition based, Proactive, and Predictive (Ugarelli, 2008). Numerous numbers of models were developed to assist in developing a strategy that reduce leakage for improved operative costs and enhance the environmental records. However, without a solid knowledge of the asset condition, the assessment of the operation component becomes very hard. Gathering and documenting information about the system will entail some expenditure for sure, but this initial cost will help not just to reduce unwanted expenses in the future, but also enable a services provider to manage the asset better.

C. Expansion Potential

It is essential that the relevant major construction projects, in particular those for water production and transmission, are well identified during the preparation stage. Early (or late) expansion of the system may cause disturbance to the overall planning and may result in the Contractor's inability to meet the contract requirements. The following factors typically cause the need for facility upgrade and/or expansion:

Increase in Population: In Atlanta, the private partner inherited from the city a backlog of between 4,000 and 7,000 outstanding requests for service. This was accompanied with a construction boom in the service area, which created additional demands that was not accounted for during bidding stage. Additional investment to meet the increase in demand was not envisioned during the bidding process.

Increase in Usage: In some cases, the improvement of service have encouraged more use in water while the company may not be prepared for investing on this direction. In some cases, the contract is only set for providing service. Inability to meet the stakeholders' expectation can draw major negative political implications on the project. In some other cases, preventing the use of private wells led to an unexpected increase in usage.

Improvement in Quality: The private operator is obliged to follow the minimum performance criteria set in the contract. This may require replacement of inappropriate connections (which is considered as the most common source of physical leaks), which in some cases does not form part of the private sector scope of work. Also, it may have not been foreseen as a consequence of years of limited or inappropriate data collection. The timely implementation of such improvement has been a key factor in success. If not considered in the original private sector planning, the process may be delayed causing problems in the project delivery. In some instances, the involvement of a locally experienced Contractor have helped improved the process like in the case of Côte d'Ivoire (Martin, 2009). SODECI, a governmental entity, has always been in charge of regular extensions of distribution networks which assisted when it became responsible for identifying and preparing the capital investment program.

D. External Impact

Close coordination between the proposed project objectives and other inter-related projects is essential. Disruption on the program may have negative implications on the PPP project, due to one (or more) of the following factors:

A party not performing the promised investments: The delay in awarding (or completing) a relevant project may have a severe impact on the PPP project in hand. The delay may result in the contractor not being able to meet the contract specifications in terms of production or in terms of meeting the contract specified environmental regulations. The case of Manila is the most revealing, one of the reasons that led to the cancellation of the project was the government inability to complete the relevant river-basin project. In the case of Atlanta, the public partner responsibility included flushing of the wastewater system which the private operator claimed was not performed as planned preventing them from meeting the environmental criteria. The City of Atlanta denied the accusation yet the city auditor confirmed that the city had indeed failed to reinvest savings in its utility by charging its water department an annual franchise fee, the city had transferred US\$9.8 million a year to its general fund (Reinhardt, 2003). A study conducted by the World Bank (2009) advises that the experience in Africa evolved to forming the so-called Public Assets-Holding Companies (AHCs) to act as owner of the water supply assets. However, the delay in implementing extension programs by AHCs have, in some cases, caused major problems to the operator. In Guinea, the AHC's delays in implementing extension programs frustrated the operator, and was encouraged to seek financing for implementing its own projects with adversely impacted the operational performance. In Senegal, initial delays in implementing rehabilitation programs meant that the AHC had to compensate the operator for loss of revenues.

Project affected by others' underperforming facilities: In Halifax, the contract was set so that the city controls what goes into its sewer system. The city enforced a sewer-use bylaw to prevent hard-to-treat industrial pollutants from contaminating the influent but the city's regulation of discharges from some 5,000 sources will only be as effective as the monitoring and enforcement behind it with no clear identification in the contract. The latest information on the quality of influent quality was due to the inability to control over 5000 sources, which does not form part of the Contractor's scope of work.

E. Commercial and Law

Unsuitable Commercial Model: A suitable commercial model is essential for the successful delivery of the PPP project. Experience shows that the transfer of significant financing responsibilities to the private partners may create problems. This was obvious in the case of Cochabamba, Bolivia. The private investor - quickly after award - increased supplied water by 30 percent, simply through repairs and technical enhancements. However, the concession included operation of the existing water supply system and construction within two years of the US \$214 million Misicuni Multipurpose Project (MMP), which used the River Misicuni for electricity generation, irrigation and water supply to the city. In order to meet these requirements, an average tariff increase of 35% was agreed upon during contractual negotiations. The government committee that negotiated the contract did not appreciate the financial implications when it insisted on the construction of the Misicuni dam, a project that was not deemed financially viable by the World Bank and international water companies. The government also insisted that the private sector sign and execute a contract for construction of a treatment plant that the consortium thought expensive and unnecessary (UNDP, 2012). In developing countries, the risk is more pronounced, as noticed in failed PPPs in Gambia and Chad, where the design of the capital budget was ill-matched with the PPP objectives (World Bank Group, 2009). In the case of Gambia's joint power/water operation, 85

percent of the revenues were generated from the sale of electricity, but no financing was available for rehabilitating and extending the power production and distribution infrastructure, in particular to replace a generator that collapsed the day before the operator mobilized (World Bank Group, 2009).

Skewed Tariff Structure: This may have significant implications on the satisfaction of stakeholders and in turn the overall delivery of the project. In the case of Cochabamba, Bolivia, an "Increasing Block Tariff (IBT)" was issued to ensure that high-income households would pay around twice the amount per cubic meter for consumption above 12 m³ that low-income users would pay. While the average tariff increase was 35 percent, the actual increase varied; lower-income consumers for increases of as little as 10 percent while higher-income consumers experienced tariff increases as high as 106 percent due to the increased tariff for their high level of consumption (UNDP, 2012).

Billing: In Africa, billing to public agencies represents 15 to 25 percent of the total billing. Water bills owed by public agencies have been a constant source of conflict between private operators and governments. In Côte d'Ivoire, this has been a recurrent problem, solved only temporarily by the sector adjustment in the late 1980s. Some countries have introduced special arrangements to mitigate the associated financial risk to water utilities and protect the revenues. In some countries like Senegal and Niger, an upgrade of the internal plumbing of public buildings to limit water consumption has been introduced. However, the improvement in billing administration has got several faces. It may lead to a reduction in consumption as a result of water rationing. However, in some cases, the opposite may occur, when the greater availability of water lead many consumers to increase their consumption, which creates an increased water bills not only because of an increase in price but also because of an increase in volume.

Exchange Rate and Fixed Assets: Water Projects include considerable fixed assets that are considered irreversible. It is therefore prudent to ensure the commercial scheme has reduced the exposure to the risk of increase in exchange rates. Even in PPP where the investment program is financed by the partner government, the operator must still finance operating expenses to cover the expatriate staff and imported inputs (chemicals, spare parts, hardware, and software). These costs are in foreign currency, while the operator's revenues are in local currency only. Financial problems plagued privatization in Buenos Aires, where a private investor won a 30-year water and wastewater concession in 1993. The private investor increased water coverage, billing collection, operating efficiency. Although it initially promised to reduce tariffs by almost 27 percent, over the years it obtained a number of price adjustments, the first because of the city's inadequate records and the unexpectedly poor condition of the water distribution network. However, the Argentine financial crisis of early 2002 wreaked havoc on the concession. The peso was "de-pegged" from the dollar and devalued, the private investor had trouble servicing its debt, most of which was denominated in U.S. dollars. When the government refused to raise prices to offset the devaluation, the consortium announced its desire to pull out of the agreement, and the matter went into arbitration (Brubaker 2003). Guaranteed foreign exchange rate is typical where the foreign exchange risk is limited as the exchange rate to the Euro (or USD) is fixed, and the difference between inflation rates can easily be taken care of through cost index formula. A study by the World Bank (2009) of seven African countries in the sample of PPP showed Cape Verde, Ghana, and Guinea—countries with floating local currencies—have faced a higher foreign exchange risk.

Exclusive Right to Water Resources: To make the project financially viable in the case of Cochabamba, Bolivia, the private sector was granted the exclusive right of water resources in Cochabamba as well as any future sources required for the supply of water

to the consumers in the city. As a consequence, many private wells were shut down. This decision carried significant negative political implications (UNDP, 2012).

F. Stakeholder Management

Poor Involvement of Stakeholders: Considering the use of PPPs for water supply services always leads to an emotional debate. Consulting local stakeholders helps to clarify the objectives of PPPs. At the design stage, several of the PPPs documents have paid particular attention to consulting with stakeholders, including various government departments, management and staff of the public utility, and the media. Typical fears include steep tariff increases, massive staff reduction, heavy foreign presence, or exclusion of the poor. Expanding the customer base has often been a key factor for contracts to achieve financial sustainability. In Cochabamba, it was concluded that public officials should have better informed the public about the size and rationale for the tariff increase. Only after three months into the operations, significant public opposition emerged. A series of protests against the contract and the increase in water tariffs took place. Within weeks, public demonstrations prompted the government to roll back the rates and force a refund of the difference paid. The protests continued and escalated to the point that the military was sent into Cochabamba to restore calm. In the deteriorating situation, the working personnel abandoned their offices and the government cancelled the contract (UNDP, 2012).

Public Sector Involvement: The operator should be closely associated with defining and implementing the rehabilitation and extension of distribution networks and with rehabilitating key plants. Experience shows that even for PPP with public funding for investment, operators should play a role in implementing civil works. The involvement of local private operators managed by nationals typically helps in dissipating the perception of foreign involvement in a socially sensitive sector and increases the acceptability of PPPs. This was witnessed in Côte d'Ivoire and Senegal. At the opposite extreme, the perception of foreign-managed operator was strong in Gambia, Chad, and Mali and was one reason that that led to termination of the contracts (World Bank, 2009). In Côte d'Ivoire, the asset capital became public in 1978 and rapidly became one of the largest companies quoted at the Abidjan stock exchange. It is owned by hundreds of local shareholders and the company's own staff has been crucial in establishing a sustainable partnership between an African government and an African private operator. Shares of the private operators in Senegal, Niger, and Gabon are also held by local partners and by staff. Guinea's failure to foster local private management at SEEG was largely due to the structure of the company's ownership, with a 49 percent minority share held by the government.

Poor Selection of Local Partner: In Chad, the PPP ran into early trouble partly because financing for a new power plant had not been secured on time and the construction contracts that were awarded to inexperienced contractors for a 350 km pipeline and power plant had to be terminated for poor performance (World Bank, 2009).

CONCLUSION

In the light of the above discussion, the main risks factors associated with water PPP projects are summarized in Table 1 below.

Table 1: Water-Specific P3 Risks

Group	Description
A: Difficulties in Obtaining/Verifying Existing Facility Records	A1: Absence of maintenance records
	A2: Absence of environmental data sampling records
B: Difficulties in Verifying the Asset Condition	B1: Uncertainty of value of assets B2: Uncertainty of cost of maintenance
C: Need for Unsustainable Expansion of Facility/Utilities	C1: Potential increase in served population
	C2: Potential increase in usage
	C3: Increase in resources to meet environmental guidelines
D: Adverse Impact from Interdependent Facilities	D1: Improper planning of interrelated projects
	D2: Uncontrolled performance of interrelated projects
E: Enforcement of New Commercial and/or Legal Regulations	E1: Overly complicated commercial model
	E2: Potential excessive increase in tariff structure
	E3: Enforcement of right to water resources
	E4: Significant change in current billing practice
	E5: Potential change in currency exchange rates
F: Mismanagement of Stakeholders	F1: Poor communication with stakeholders
	F2: Potential disruption to current local businesses
	F3: Underperformance of a local partner

SUMMARY

In the early 1990s, market-driven approaches for water resources management started to gain acceptance. Water was recognized as an economic good. Privatization and decentralization have become the main reform policies of the major international organizations (World Bank, International Monetary Fund, Organization for Economic Cooperation and Development). Public-Private Partnerships (abbreviated as PPP, or P3) have been introduced as the most common scheme of project development. The involvement of the private sector in water infrastructure projects is a subject of much debate, which is currently far from being settled. Statistically, water projects undertaken under private sector are experiencing cancellation/distress at a much higher rate than other infrastructure projects under the same procurement scheme. Both proponents and opponents of water privatization support their claims with figures that should strengthen each party’s argument. However, in lack of a common base of comparative analysis, these numbers were not indicative and could be considered as outliers.

A research on Water PPP is not expected to conclude on the debate on this matter. However, a better understanding of the risks involved in water PPP projects can significantly assist in designing containment measures to deal with their likely impact on the projects. As such, a research plan was set to develop the “Water-Specific P3 Risk Model” which offers a platform to incorporate tangible and intangible risk variables into a risk assessment process in water infrastructure projects.

This paper presented the literature review undertaken for the identification of the risk factors associated with water PPP projects. As a primary stage, a critical review was undertaken for the arguments raised by both sides of the debate on water PPP. The review showed that most arguments are driven by ideological pre-set opinions that led to making invalid assumptions, exaggerated claims, omission of facts, or was found contradictory in some cases. Subsequently, the author conducted an extensive review of water PPP projects cancellation including studying several published material and case studies. This paper presents the outcome of the literature review process where a

summary of identified risks is presented in conclusion. The subsequent research stage will seek the industry experts to evaluate the identified risks through a questionnaire survey, where the outcome of the survey will be analyzed using the Analytic Network Process (ANP) to demonstrate the complex interactions among those risks. The "Water-Specific P3 Risk Model" resulting from this research remains limited to the cases in hand and the opinions of the experts who contributed to this research. However, the proposed model offers an opportunity for future research to build on what has been achieved.

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