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An Exploration of PPP Infrastructure Projects' Risks in Supporting Sustainable Development and SDGs

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Abstract

Iraq has initiated "Iraq Vision 2030" as a participation in the global efforts to attain sustainable development and the United Nations' Sustainable Development Goals (SGDs). The private sector engagement in infrastructure development was adopted as a national goal. However, no serious accomplishment has been made. Accordingly, this research was conducted to explore risk factors affecting sustainable development in public-private partnership (PPP) infrastructure projects. 116 risk factors were identified through literature review; for proper assessment, monitoring, controlling, and management, they were classified into two groups. The first group includes risk factors that may appear at a specific stage of the PPP project lifecycle. The second group includes risk factors that may appear at any time along the PPP project lifecycle. A field study has been implemented in two stages; the first stage is an open questionnaire and face-to-face interview with PPP experts to finalize and approve proposed risk lists. The second stage is a closed questionnaire; the mean value was used to rank and identify respondents' agreement on rating the level of importance of these risk factors supported by nonparametric tests. Findings indicated that the critical-level risks form nearly two-thirds of the overall and first-group risks and more than two-thirds of the second-group risks. Financial and fiscal sustainability concerns form a serious challenge, as they came in at the top of the critical-level risk factors. Overall findings indicate the importance of legislating a PPP law that serves the achievement of "Iraq Vision 2030" national goals and the UN's SDGs and provides a comprehensive framework that protects citizens' rights, ensures their well-being, and supports sustainable development.

Keywords: PPP Risks; Public–Private Partnership (PPP); Sustainable Development; SDGs; Infrastructure Projects.

1. Introduction

Budget constraints pose a significant challenge for many governments, limiting their capacity to address the increased demand for infrastructure and public service provision. Consequently, many governments are inclined to implement non-traditional creative delivery systems to address the imbalance in supply and demand, with public-private partnerships (PPP) being one of the most favored approaches [1]. The UK was the first to adopt the PPP approach in the 1990s [2]. This arrangement involves a long-term contractual and cooperative partnership between the public and private sectors. According to the agreement, the private sector is tasked with designing, financing, building, and operating public facilities to achieve optimal long-term objectives for "Value for Money (VfM)" [3, 4]. Public-Private Partnerships (PPP) are recognized as a viable approach to address inadequate government funding, the public sector's limited skills and experience in infrastructure maintenance, and the distribution of risks associated with infrastructure projects. Consequently, PPPs have been extensively adopted in infrastructure initiatives globally [5, 6]. Public-private partnerships have experienced significant growth globally over the last twenty years, a trend that is expected to continue.

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Public-private partnerships have consistently represented the dominant framework in the global infrastructure sector. The system has become predominant in project delivery, serving as an effective tool for the development of large-scale projects worldwide, while also introducing a high degree of complexity that compels stakeholders to address unprecedented socio-technical challenges. PPP has significantly contributed to the sustainable development of infrastructure. In this context, public-private partnerships (PPP) are closely linked to sustainability by addressing infrastructure shortages and mitigating potential negative impacts on economic, environmental, and social dimensions [7-11]. Public-private partnerships have played a crucial role in the sustainable development of infrastructure. It can also act as a catalyst for sustainable growth in large-scale infrastructure projects [12]. The aim is not to provide sustainable solutions for project maintenance through improved product quality and cost reduction. Furthermore, it has the potential to shorten project duration, improve technical aspects of construction and maintenance methods, encourage contractor innovation, and lessen the project's effects on users and the surrounding environment [13-17].

Over the past decade, following the announcement of the Sustainable Development Goals (SDGs) by the United Nations, there has been significant attention directed towards the concepts of project resilience and sustainability, leading to their increased prevalence [18-21]. The growing focus coincides with significant initiatives within the construction industry to integrate the three dimensions of sustainability across all life stages of infrastructure projects and buildings. Resilience is typically associated with the capacity to respond to extreme circumstances and events. The concept of project resilience has expanded beyond the confines of construction, planning, and environmental resilience in response to ongoing challenges and new incidents. It now encompasses essential aspects of project management, including fiscal stability, feasibility, and long-term social and economic benefits [22-25].

Private funding, innovation, and proper risk sharing are the main attributes of the PPP approach [26]. They are considered key promoters that support the achievement of sustainable development and the SDGs. Risk transfer to the private partner is the most effective feature of PPP [27]; the greater the involvement of the private partner, the greater the benefits obtained from transferring risks to that partner. Fleta-Asín & Muñoz [28] found that projects executed under risk governance frameworks, where the private partner assumes greater responsibility, tend to attract increased private investment. Private entities have a strong competitive orientation and are more experienced in managing risks; therefore, they are more capable of providing and managing public services effectively and efficiently [29]. Moreover, PPP viability depends on reasonable and appropriate risk sharing due to its role in assessing and developing Value for Money (VfM) [30]. However, many PPP projects fail to achieve their planned and desired results because of the various risks encountered throughout the PPP project lifecycle, which represent serious barriers to PPP project success in supporting the attainment of sustainable development and the SDGs [13, 31].

Risks associated with PPP agreements have been studied extensively by researchers due to their long-term contract period and the complexity of the structure of this type of contract. Hwang et al. [32] identified 42 important risk variables affecting PPP projects in Singapore, attributed to both the government and the private sector. Tang & Shen [33] identified 18 risk variables pertinent to stakeholder demands in a Hong Kong PPP project through literature research and interviews. Shao et al. [34] identified 29 residual value risk indicators pertinent to road PPP projects in China and their principal characteristics. Li & Wang [35] assessed risks affecting the sustained benefits of global PPP initiatives from the perspectives of various stakeholders. By identifying key stakeholders' objectives and analyzing the impact of various risks on these objectives. It was revealed that inflation significantly heightens the probability of project failure, whereas expertise in public-private partnerships, involvement of federal governments, and currency volatility considerably improve the success of PPPs. Selim [36] conducted a survey to detect the appropriate PPP arrangements and evaluate prospective major risks related to economic and community conditions regarding clean water provision. Wang et al. [20] adopted a social network framework to examine risks associated with infrastructure PPP projects for sustainable implementation. Consequently, the data indicated that the principal risks were categorized as two types: type one comprising elements with significant and independent impact, including governmental approvals, lateness, lack of sovereign guarantee, and lack of legal framework. Type two includes accomplishment risks, revenue fluctuation, and fee alterations. Crucial intermediaries were identified in the network, such as legislation changes, public objections, and financial risks. Khahro et al. [37] have developed a risk severity ranking model utilizing 47 critical risks in Public-Private Partnership projects. A comparative analysis has been performed utilizing existing research on PPP in developing countries. Identified principal risks of PPP initiatives in underdeveloped countries, predominantly financial and public-centric. The risk severity rank model will enhance the importance of the PPP idea, aligning with United Nations Sustainable Development Goals; Fleta-Asín & Muno [28] examined the influence of project risk-sharing mechanisms in regard to the magnitude of the attraction of investors in clean energy initiatives involving both governmental and private sector participation. A sample including 2,215 projects conducted in 73 developing countries from 1997 to 2019 was studied to identify risk factors that affect investor attraction at both levels, institutionally or in the project level as well.

To facilitate analysis, some researchers have categorized risk factors into distinct classifications. Aziz & Shen [38] asserted that force majeure risks constitute a risk category for meticulous management due to their potential to inflict substantial losses on the private party. Doloi [39] delineated the risk features linked to the PPP procurement process

across three dimensions: time, cost, and operational performance. Tang et al. [40] conducted a literature study on the utilization of PPP in Australia, identifying four primary categories of factors: procurement, stakeholder, risk, and finance. Ameyaw & Chan [41] classified PPP risks into eight categories in their study of Ghana's water supply project management: political and regulatory risks, operational risks, market/revenue risks, financial risks, relationship risks, project and private consortium selection, social risks, and third-party risks. Song et al. [42] performed interviews, questionnaires, and site visits to selected PPP projects, identifying 10 principal risks in their analysis of the significant risks associated with PPP waste-to-energy incineration facilities in China. The authors subsequently conducted a comprehensive examination of these risks, primarily encompassing those related to governmental decision-making, governmental credit, legal and regulatory matters, technical considerations, contract modifications, public dissent, payment, and income. Ameyaw & Chan [43] compiled a list of risk factors, ranked them, and identified the 'top-ranked' risks as including inadequate contract design, uncertainties in water pricing and tariff reviews, political interference, public opposition to the PPP, construction delays and cost overruns, non-payment of invoices, insufficient PPP experience, financing risks, erroneous demand forecasting, elevated operational costs, and conflicts among partners.

Regarding the case of Iraq, the increasing need for infrastructure, population growth, and limited financial resources have collectively incentivized the Iraqi government to adopt the PPP approach, as well as to encourage private sector engagement in infrastructure development since 2014. Accordingly, researchers have studied this subject intensively. Alsaffar & Altaay [1] identified 87 risk factors classified into eight groups related to privatization and investment policy; economic; legal and political; financial and commercial; administrative and organizational; social and environmental; technical and support; and government motives and guarantees. Al-Juboori [44] identified thirty risk factors associated with PPP projects, categorized by project phases: development, construction, operation, and the overall project life cycle. Rezouki & Hassan [45] identified twenty-five risk factors associated with PPP projects and categorized them into four primary groups: political situation concerns; financial; legal and organizational; and functional risks. Abd Alkreem and Breesam [46] identified twenty-one risks affecting PPP implementation and categorized them into two major groups: legal and political aspects and government support aspects.

In 2019, the Iraqi government initiated “Iraq Vision 2030” as a committed member of the UN working toward the attainment of the UN SDGs [47], in which private sector engagement in infrastructure development was adopted as a national goal. Although both sustainable development and PPP concepts have recently been practiced in Iraq, the efforts made in this regard have unfortunately been unpromising. Therefore, this study was conducted to comprehensively explore risks in PPP infrastructure projects to support the attainment of sustainable development and the SDGs in Iraq.

2. Literature Review

2.1. Sustainable Development and Public-Private Partnership Projects

The Brundtland Commission defined sustainable development in 1987 as development that fulfills the needs of the present generation while ensuring that future generations can meet their own needs [48]. Rijsberman & Van de Ven [49] argue that sustainability includes the needs of future generations, the carrying capacity of supporting systems, and the maintenance of ecological, environmental, and hydrological integrity. Koppenjan & Enserink [50] distinguished between social, environmental, and economic sustainability. Social sustainability concerns the impact of urban infrastructure on the cost and accessibility of public service delivery for economically disadvantaged groups in urban society [51, 52]. Environmental sustainability relates to the impact of public infrastructure service delivery on urban populations, urban habitats, and the surrounding environment [53]. Financial sustainability refers to the ability of authorities to meet the financial obligations associated with infrastructure projects, both in the short and long term [54]. To guide the rapid urbanization process towards sustainability, enhancing public-private partnerships is one approach that involves the private sector in the creation, maintenance, and operation of sustainable urban infrastructure. However, this process faces challenges, as many PPP initiatives prove unsustainable or ultimately do not come to fruition. Research has begun to investigate the relationship between PPP risks and the sustainable growth of PPP projects.

Bai et al. [55] introduced the concept of "sustainability" into the risk assessment of PPP projects, creating a factor system comprising five primary factors and 72 secondary factors to assess the sustainability risk level of these projects. Yuan et al. [56] found that social and environmental factors, including construction delays, noise pollution, and inadequate compensation for land acquisition, are more likely to create social risks in transport PPP projects compared to economic factors, thus affecting the social sustainability of these projects. Shen et al. [57] argued that the distribution of investment contributions between the private and public sectors is a significant factor affecting the sustainability performance of PPP-type projects. Moreover, different types of organizations, including those in the public and private sectors, are susceptible to reputational damage in unique ways [58]. The reputational risk for these firms primarily arose from their failure to fulfill social responsibilities [59, 60] and to implement sustainable and responsible supply chain management [61, 62], which ultimately affected the sustainable delivery of PPP projects.

2.2. Sustainable Development Goals and Public-Private Partnership

The adoption of the 17 Sustainable Development Goals (SDGs) by UN member states in 2015 aims to address critical challenges to sustainability, ensuring prosperity, environmental protection, and poverty eradication by 2030 [63, 64]. The adoption of these Sustainable Development Goals (SDGs) represents a fundamental commitment among scholars, project management practitioners, and government officials worldwide to collaboratively address these objectives, involving a diverse array of stakeholders [65]. The multi-stakeholder approach is closely aligned with the objectives of public-private partnerships, defined as collaborative efforts between governments and private entities to deliver long-term infrastructure and services [66-68].

The concept of People-First Public-Private Partnerships (PPP) was introduced in 2016, following the issuance of draft guiding principles for effective governance by the United Nations Economic Commission for Europe (UNECE). This study advocates for Public-Private Partnerships (PPP) as an effective mechanism for governments to achieve Sustainable Development Goals (SDGs). It emphasizes the nature of PPP arrangements concerning competence and equity, addressing governmental financial limitations and infrastructure deficits, while also highlighting their recognized potential in facilitating the attainment of SDGs [69]. The UN has advocated for the Public-Private Partnership (PPP) model to support sustainable development. Consequently, the UN has established approximately 30 international standards for PPP implementation aimed at achieving the 17 Sustainable Development Goals (SDGs) through this model [70].

The relationship between PPPs and SDGs is significant, manifesting both directly and indirectly, as these agreements facilitate the delivery of essential infrastructure and public services. Researchers examined the 17 Sustainable Development Goals (SDGs) and identified the sustainable targets associated with SDG 3, which pertains to health and well-being communities. SDG 6, which pertains to water and wastewater treatment; SDG 7, focused on affordable and accessible clean energy; SDG 9, related to industrial innovation and infrastructure; and SDG 11, concerning sustainable communities and smart cities, are all impacted by the development of infrastructural projects. Public-private partnerships (PPP) are crucial for achieving substantial sustainable development outcomes, as they directly influence the processes associated with the attainment of Sustainable Development Goals (SDGs) 3, 9, and 11 [11, 71].

Additionally, public-private partnerships (PPPs) indirectly impact sustainable development goals (SDGs) by enabling the delivery of critical infrastructure and services, thereby enhancing market connectivity, improving mobility, and generating employment opportunities [72]. Furthermore, an indirect relationship exists between the attainment of other Sustainable Development Goals (SDGs) and the implementation of Public-Private Partnerships (PPPs), attributed to managerial challenges, elevated monitoring costs, constrained innovations, and significant capital expenditures associated with these long-term agreements [11, 73]. The successful implementation of the PPP approach requires governments to consider critical success factors (CSFs) and to establish a robust enabling environment. This includes addressing issues such as the absence of a legal framework, delays in land acquisition, inadequate public administration processes, lack of sovereign guarantees, and the need to control corruption [45, 46].

Numerous successful infrastructure PPP projects exist; however, failures are also prevalent, accompanied by various risks such as financial and political uncertainties, as well as the potential for public rejection throughout the life cycle of these projects. PPP project implementation frequently encounters legal, political, and cultural obstacles [11]. The Public-Private Partnership serves as a significant project delivery system that contributes to the sustainable development of public facilities and infrastructure. This study will explore and identify key risk factors that can positively or negatively influence this approach in achieving sustainable development in PPP infrastructure projects.

2.3. Public-Private Partnership Risks Identification and Classification

Risk management consists of four stages: identification, assessment, development of a response plan, and proper allocation of contingencies [63–65, 74–76]. The most crucial stages in this process are risk identification and allocation [67, 76]. To date, these have been viewed as specialized technological and administrative challenges [68, 69, 77, 78]. According to Osei-Kyei et al. (2023) [76], risk identification is the initial stage in the risk management process and serves as the foundation for risk assessment and evaluation. The development of effective methods and specialized instruments is at the core of risk identification [70, 79]. Researchers have developed and classified risks through various approaches [68, 71–74, 77, 80–83]. Table 1 summarizes a number of these studies.

From the literature review, 116 risk factors have been identified, as presented in Table A1 in Appendix I. The implementation stages of the PPP project lifecycle consist of five stages: “identification,” “procurement,” “design/construction,” “operate/maintain,” as well as the “transfer” stage [26, 91]. Each stage represents a distinct milestone throughout the long-term PPP project contract [91, 92].

Table 1. Risks identification and classifications by various scholars

S.N.	Risk Classification	References
1.	Eight types of risk were identified and broadly categorized into global and elemental risks.	Grimsey & Lewis [8]
2.	PPP risks are classified into general risks and project-specific risks according to their origin.	Ng & Loosemore [84]
3.	PPP risks are classified into three categories: investment environment risks, project risks, and partnership risks.	Ni [85]
4.	Fourteen country-level risks, seven market-level risks, and sixteen project-level risks were identified.	Ke et al. [86]
5.	The risks associated with the PPP model are categorized into three segments: Macro risks primarily encompass political, legal, macroeconomic, social, and natural risks. The intermediate risks primarily pertain to the process, including project selection, design, financing, construction, and operations. Micro risks primarily encompass cooperative relationships and third-party risks, which are the most commonly referenced risks in PPP projects.	Li [87]
6.	Identified 59 individual risks, categorizing them into external risks (macro risks) and internal risks, which include meso risks (related to the project) and micro risks (related to specific components).	Mohd-Rahim et al. [88]
7.	A systematic literature review was conducted, resulting in the identification of 86 unique risks, which were categorized according to the project cycle.	Le et al. [89]
8.	Identified 35 distinct individual risks to create a severity matrix.	Khahro et al. [37]
9.	Classified into: 1) Domestic Risk, which includes market risk, also referred to as commercial risk or revenue risk, associated with the capacity to acquire infrastructure services at market prices. The fiscal position of the government reflects its constraints and capacity to meet its obligations. Country risk highlights the unique attributes of each nation's natural and economic resources, political and regulatory frameworks, political stability, fiscal and monetary conditions, and their historical experiences with public-private partnerships (PPP). Currency risk refers to the potential for financial loss due to fluctuations in exchange rates. It is a significant consideration for investors and businesses engaged in international transactions. Credit risk and liquidity risk. Risks associated with construction and those specific to particular sectors.2) International Risk that include Risks Transmitted through the Global Real Economy. Risk Transmitted through the Global Financial Market	Li & Wang [35]
10.	Enhanced the analysis of mining risk by incorporating economic, political, contractor, and civilian risks as fundamental components of social risk.	Guo et al. [90]

As this study aims for a proper assessment, monitoring, controlling, and management for risks throughout the PPP project lifecycle implementation, risks were classified into two groups. The first group (Group 1) includes risk factors that may appear at a specific stage of the PPP project lifecycle [77, 93]. The second group (Group 2) includes risk factors that may appear at any time along the PPP project lifecycle [78, 94]. Thus, the risk monitoring and management became more effective. Accordingly, the same approach adopted by [78-80, 94-96] has been followed. Under each group have been listed second-level sub-groups. The first group consists of five subgroups presented in Table 2, representing the PPP project lifecycle's standard phases, including:

- Risks associated with the "identification" phase, arise from the original ideation and project conceptualization phase till the publication of a request for proposals (RFP). The majority of activities in this phase are to project evaluations and decision-making processes. The most commonly cited risk in the literature is 'Problems with project approval and permits,' with a frequency weight of 2.7%. The frequency weight of each danger is the percentage of each risk's contribution to the total sum of 604 frequencies. As obtained from the literature and presented in Table A1 in Appendix I as well as presented in Table 2.
- During "Procurement" phase, risks may arise when the PPP sponsor releases a Request for Proposals (RFP) until a contract is awarded and financial closure is achieved. The risk of imperfect contracts constituted the largest frequency weight proportion at 2.2% of the risks in this period.
- The "Design and construction" phase commences post-financial closure, encompassing design and construction, and concludes with the finalization of the infrastructure asset. The predominant risk is construction cost overruns, with a frequency weight percentage of 2.3%, followed closely by issues related to land acquisition and compensation, which have a frequency weight rate of 2.2%.
- Risks related to "Operation and maintenance" phase connected to the operational and maintenance procedures over a specified contract period, the most extended phase in a PPP project. Most of the risks occur in the stage in which approximately 23 risks are structured in three levels. The risk of 'Operation cost overrun/Escalation' possesses the highest frequency weight at 1.8%, followed closely by the risk of Demand change at 1.7%.
- Upon the expiration of the service contract for PPP projects "Transfer" phase starts, where the infrastructure is returned to the government. Residual value risk exhibits the largest frequency weight at 1.5%, followed by completion risk at 0.8%.

Table 2. Risk Factors that may encountered within specific phase of the project life cycle (Group 1)

	Risk Factors	Frequency Weight
1.1	***Identification***	
1.1.1	Delay in project approvals and permits / Insufficient public administration processes	2.7
1.1.2	Strong political opposition/hostility (Political concerns of foreign takeover or transfer of fund)/ Political interference	1.5
1.1.3	Financial attraction of project to investors (Low attraction of funding)	1.3
1.1.4	Lack of a standard model for PPP agreements	0.5
1.1.5	Problems related to financing methods and supply	0.3
1.1.6	Problems with environmental approvals	0.2
1.1.7	Inadequate feasibility study	0.2
1.1.8	Subjective project evaluation method	0.2
1.1.9	Faulty financial structure	0.2
1.1.10	Unclear project objectives	0.2
1.1.11	Lack of harmony between project and society	0.2
1.2	***Procurement***	
1.2.1	Excessive contract variation/ Imperfect contract risk	2.2
1.2.2	Higher than expected finance costs / High finance cost	1.3
1.2.3	Inadequate distribution of responsibility and risk	0.8
1.2.4	Contractual dispute /Litigation or inordinate	0.7
1.2.5	Limited capital / Financial constraints	0.5
1.2.6	***Bidding* risks**	
1.2.6.1	Non-competitive tender /Lack of enough qualified bidders	1.0
1.2.6.2	Lack of transparency in bidding / Insufficient bidding process	0.5
1.2.6.3	High bidding costs / High tendering cost	0.5
1.2.6.4	Inadequate negotiation period prior to initiation	0.3
1.2.6.5	Delay in financial closure	0.3
1.3	***Design and Construction***	
1.3.1	Construction cost overruns	2.3
1.3.2	Land acquisition and compensation / Site availability	2.2
1.3.3	Availability of appropriate labor/material	2.0
1.3.4	Construction time delay / Project delay / Inappropriate schedule	2.0
1.3.5	Design deficiency/ Design flaws	1.8
1.3.6	Unexpected Geotechnical conditions/ground condition Unexpected site conditions	1.8
1.3.7	Inadequate design in response to environmental sustainability and resilience	1.2
1.3.8	Contractor failure / Capability of SPV	1.2
1.3.9	Poor organisation and coordination risk	1.2
1.3.10	Late design changes	0.8
1.3.11	Supporting facilities risk/necessary infrastructure risk	0.8
1.3.12	Poor quality of workmanship	0.8
1.3.13	Change of scope	0.8
1.3.14	Consortium inability	0.7
1.3.15	Insolvency/default of subcontractors and suppliers	0.7
1.3.16	Problems related to construction safety	0.5
1.3.17	Quality risk	0.5
1.3.18	Problems with resettlement and rehabilitation	0.3
1.3.19	Lack of environmental pollution governance	0.3
1.3.20	Environmental & biodiversity damage	0.2
1.3.21	Failure to meet performance criteria	0.2
1.3.22	Problems with construction logistics	0.2
1.3.23	Damage to Project structures, construction equipment, labor ...	0.2
1.3.24	Waste of material	0.2
1.3.25	Technological Risk	-
1.3.25.1	Unproven engineering technique / Testing new practices	0.8
1.3.25.2	Technology risk	0.5
1.3.25.3	Faulty techniques	0.2
1.4	***Operation and Maintenance***	
1.4.1	Operation cost overrun/ Escalation	1.8
1.4.2	Maintenance cost higher than expected	1.2
1.4.3	Operator default /Operator inability /Inability of concessionaire	1.0
1.4.4	Risk regarding pricing of product/service	0.5
1.4.5	Quality of operation / Failure to meet service quality	0.5
1.4.6	Public resistance to pay/ Revenue risk from end user	0.3
1.4.7	Project / Facility/ service quality deterioration	0.2
1.4.8	***Operation Issues***	
1.4.8.1	Low operating productivity / Low productivity	0.8
1.4.8.2	Project/operation change	0.5
1.4.8.3	Problem related to operation safety	0.3
1.4.8.4	Negligence of operation by concessionaire	0.2
1.4.9	***Revenue Risks***	
1.4.9.1	Demand change risk	1.7
1.4.9.2	Competition risk / Project Uniqueness	1.0
1.4.9.3	Operation financial risk (operational revenue below expectation)	0.8
1.4.9.4	Low demand	0.2
1.4.9.5	Inaccurate demand forecasts	0.2
1.4.9.6	Loss due to operational problems	0.2
1.4.10.	***Fee Risks***	
1.4.10.1	Price / Fee / Toll change	0.3
1.4.10.2	Inadequate government supports for fee enforcement	0.2
1.4.10.3	Alteration in toll /fee structure	0.2
1.4.10.4	High tolling/ Fee rate	0.2
1.4.10.5	Lack of management for public grievances and end user feedback	0.2
1.5	***Transfer***	
1.5.1	Residual value (after concession period) / asset risk	1.5
1.5.2	Completion (handling over) risk	0.8

Meanwhile, the second group comprises seven sub-groups of risk factors at the second level, as illustrated in Table 3. The majority of risks in this category pertain to the macro environment, including commercial, financial, legal, political, economic, and force majeure factors; consequently, they are likely the most challenging to manage. Previous studies have classified risks in this group into various categories, including 'General risks' [84], "domestic and international risks'' [90], 'Investment Environment Risks' [85], and 'Exogenous risks' [88]. The relationship risks encompass additional risks associated with the interactions among various partners, which may influence the success of PPP projects [87, 88].

Table 3. Risk factors that may encountered across the project life cycle (Group 2)

S.N.	Risk Factors	Frequency Weight	S.N.	Risk Factors	Frequency Weight
2.1	***Political***		2.4	***Commercial***	
2.1.1	Expropriation/nationalization of assets	1.8	2.4.1	Tariff change	1.3
2.1.2	Unstable government	1.7	2.4.2	Fluctuation of material cost (by government)	0.7
2.1.3	Corruption	1.3	2.4.3	Fluctuation of material cost (by private)	0.7
2.1.4	Inconsistencies in government policies	1.0	2.4.4	Level of demand for the project	0.7
2.1.5	Government commitment/weak support from government officials	0.8	2.5	***Economic***	
2.1.6	Government interference	0.7	2.5.1	Inflation	2.5
2.2	***Legal & Institutional***		2.5.2	Interest rate volatility	2.2
2.2.1	Change in law /Legal change	2.3	2.5.3	Foreign exchange and convertibility	1.8
2.2.2	Poor public decision making process/ Insufficient authority	2.0	2.5.4	Poor financial market	0.7
2.2.3	Change in taxes regulation	1.7	2.5.5	Unfavourable international economy /Influential Economic events (decline in Oil price)	0.5
2.2.4	Legislation change/inconsistencies	1.3	2.6	***Force majeure***	
2.2.5	Inadequate experience in PPP	1.3	2.6.1	Force majeure (War/ Social unrest /Sanction)	2.0
2.2.6	Industrial regulatory change Import/export restrictions	1.0	2.6.2	Environmental sustainability risk	1.8
2.2.7	lack of respect for law (or lack of law enforcement)	1.0	2.6.3	Unforeseen sever weather conditions and climate change	1.5
2.2.8	Inadequate law and supervision system/Imperfect law and supervision system	0.3	2.6.4	Natural Disaster	0.3
2.2.9	Rate of returns restrictions	0.2	2.7	***Relationships***	
2.3	***Financial***		2.7.1	Public opposition to projects/Swings in public opinion	1.8
2.3.1	Availability of finance	1.3	2.7.2	Non -involvement of host-community	1.7
2.3.2	Lack of creditworthiness	0.5	2.7.3	Different working methods/know-how between partners	1.2
2.3.3	Inability to service debt / Risks associated with debt	0.3	2.7.4	Lack of commitment from public/private partner	1.2
2.3.4	Lack of government guarantees / lack of sovereign guarantee	0.3	2.7.5	Third party tort liability	0.8
2.3.5	Insufficient project finance supervision	0.2	2.7.6	Staff internal crisis	0.5
2.3.6	Lack of cash flow	0.2	2.7.7	Cultural differences between main stakeholders /Problems related to partnership	0.3
2.3.7	Financiers unwilling to take high risk	0.2	2.7.8	Problems related to Media	0.2
2.3.8	Delay in payment of annuity	0.2			

In terms of economic risks, inflation carries the highest frequency weight at 2.5%. Expropriation or nationalization of assets represents the most frequent political risk, with a weight of 1.8%. The availability of finance in financial risks has the highest frequency weight of 1.3%. In the context of legal risks, changes in law exhibit the highest frequency weight of 2.3%, followed by poor public decision-making processes and insufficient authority, which account for 2%. In the context of commercial risks, tariff changes exhibit the highest frequency weight, accounting for 1.3%. In the context of force majeure, War, Social unrest, and Sanctions exhibit the highest frequency weight at 2.0%, followed by Environmental sustainability risk of 1.8%, and Unforeseen severe weather conditions and climate change of 1.5%. In the context of relationship risks, public opposition to projects and fluctuations in public opinion exhibit the highest frequency weight of 1.8%, followed closely by non-involvement of the host community of 1.7%, and a lack of commitment from public or private partners of 1.2%.

3. Research Methodology

The research methodology flowchart is illustrated in Figure 1. The study was conducted in two stages. The first stage involved an open questionnaire and face-to-face interviews with 13 PPP experts to review and finalize the 116 risk

factors and to reach a consensus on the risk factor list and the proposed classification. It was observed that different wording had been used by various researchers to refer to the same risk. By unifying risks with the same nature, the final list was reduced to 90 risk factors according to the opinions of the PPP experts.

In the second stage, a closed questionnaire was implemented. Using quantitative analysis, the respondents' opinions on the research topic were identified. The closed questionnaire consisted of five sections. In this paper, only two sections are presented. The first section presents the respondents' background information. The second section presents respondents' opinions on rating the level of importance of the 90 risks approved through the open questionnaire by PPP experts, using a five-point Likert scale where "1 = least important" and "5 = very important."

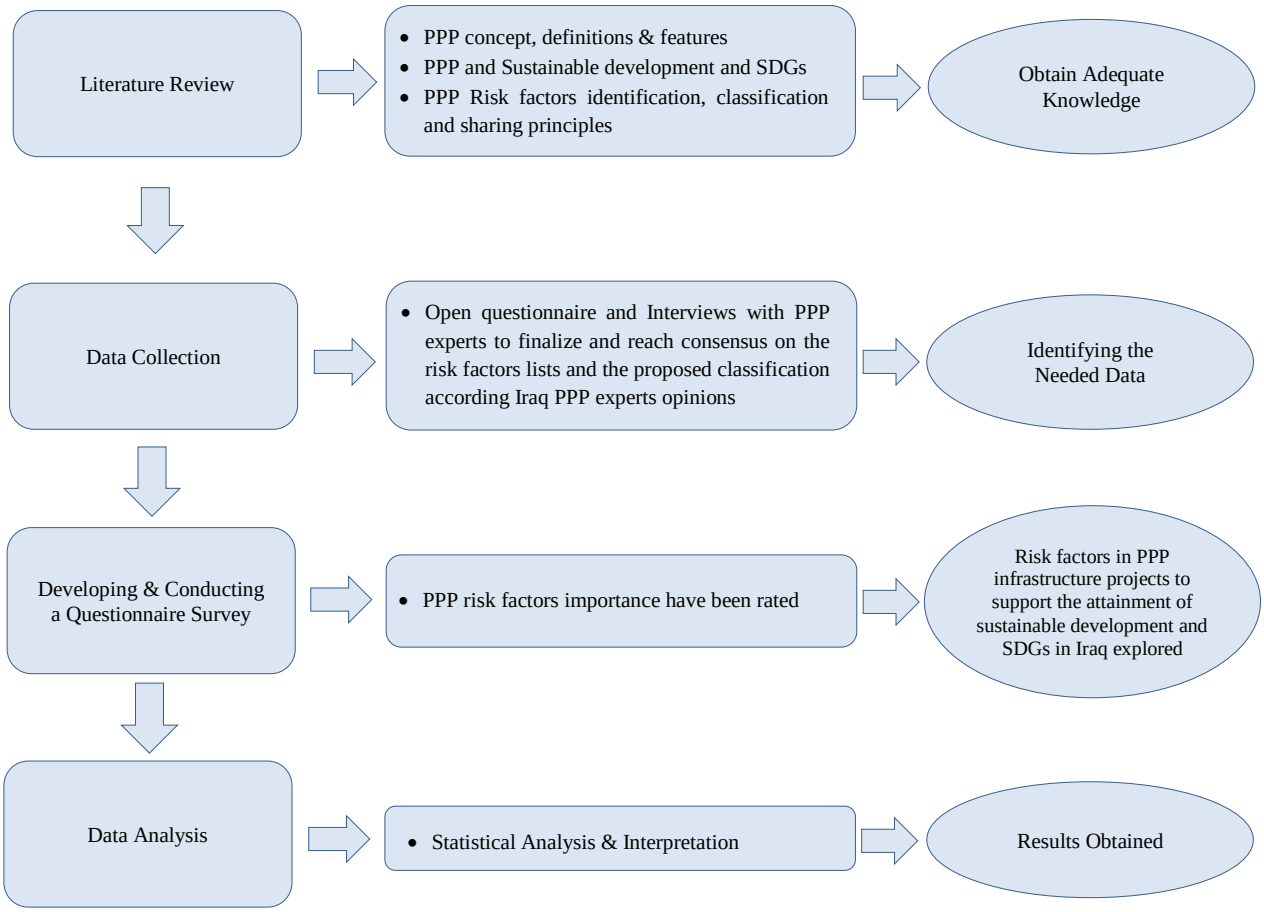

Figure 1. Research methodology

3.1. Open Questionnaire Implementation

The open questionnaire was conducted by distributing 75 questionnaire forms to PPP practitioners from public and private entities. Sixty-two questionnaires were returned, representing 84% of the total distributed forms. Fifty-two forms were considered valid as they were properly completed, while the other 10 were excluded for various eligibility reasons. Since the percentage of valid questionnaires relative to the returned forms is 84%, this is considered adequate for analysis and reporting purposes [97].

3.2. Open Questionnaire Output Analysis

Statistical Package for the Social Sciences (SPSS) version 30 was used to analyze the data obtained from the 52 valid open questionnaires. Descriptive analysis was applied to examine respondents' background information. A normality test confirmed that the data were not normally distributed; therefore, nonparametric tests were used. The analysis process was implemented as follows:

- The level of importance of risks was identified using mean ranking values in descending order.
- Kendall's $\mathcal{W}$ test was applied to determine the level of agreement within the same group.
- The Kruskal-Wallis test was used to identify differences between the two groups in the survey regarding risk ratings.

4. Results Discussion

4.1. Participants Background Information

The questionnaire was distributed among 52 professionals working on PPP infrastructure projects. As the concept of PPP has been dealt with in Iraq in the last 10 years only, there are limited professionals who have PPP experience. Probably the number will increase as the implementation of PPP projects increases in the country. Regarding the work sector of respondents, 67% of respondents were working in the public sector while 33% of them worked in the private sector, as shown in Table 4.

Table 4. Participants background information

Theme	Number of Participants		
1. Sector	Public	Private	Overall
	35	17	52
2. Years of work Experience	Public	Private	Overall
6-10 Years		2	2
16-20 Years	11	4	15
Over 21 year	24	11	35
Total	35	17	52
3. Years of experience in PPP projects	Public	Private	Overall
5 years or less	4	2	6
6-10 years	14	5	19
Over 10 years	17	10	27
Total	35	17	52
4. Academic qualification	Public	Private	Overall
Bachelor's Degree	22	10	32
High Diploma	2	1	3
Master's Degree	7	4	11
Doctorate	4	2	6
Total	35	17	52

Regarding years of work experience, nearly two-thirds of all participants have more than 21 years of experience. Participants with 16–20 years and 6–10 years of experience represent 29% and 4%, respectively. From Table 4, it can be concluded that respondents with more than 21 years of work experience constitute the majority in both sectors, indicating that the participants have substantial and reliable experience that supports the study objectives.

Regarding participants' academic qualifications, Table 4 shows that those holding a bachelor's degree form the majority of respondents, representing 62% of the total. This is followed by participants with a master's degree (21%), a doctorate (12%), and a higher diploma (6%). This variation in qualifications enhances the survey's reliability, as it incorporates diverse academic backgrounds and areas of expertise.

4.2. Risk Factors Level of Importance Ranking

The obtained mean (M) and standard deviation (SD) values, as well as the ranking of risk factors rated by the participants using SPSS, are presented in Table A2 in Appendix I. It can be concluded that:

- The mean values of all rated risks range between 4.85 and 2.08, indicating that the tested factors vary from very important to less important. According to the importance range values presented in Table 5, the rated risks are distributed into three levels of importance: low, moderate, and critical.
- From Table A2, the standard deviation values for all rated risks are small, meaning the ratings are close to the mean. This indicates consistency among participants in evaluating these risks.

- Additionally, the 90 rated risks are divided into two groups: Group 1 includes risks that may be encountered during specific phases of the project life cycle (59 risk factors), while Group 2 includes risks that may be encountered at any time throughout the project life cycle (31 risk factors).
- The numbers of risks rated as critical, moderate, and low are 53, 31, and 6, representing 59%, 34.4%, and 6.6% of all rated risks, respectively. Figure 2 presents the distribution of importance levels for all risks, as well as for Group 1 and Group 2 risks, as rated by the participants.
- Figure 2 also shows that critical-level risks constitute nearly two-thirds of the overall risks and Group 1 risks, and more than two-thirds of Group 2 risks.
- In Group 2, no risks were rated as low-level.
- Figure 3 presents the list of Group 1 risks according to their level of importance, while Figure 4 presents the list of Group 2 risks according to their level of importance.

Table 5. The importance of range and risk factor status

Mean value	Degree of importance	Risk factor importance level
4.2-5	Very Important	Critical Level
3.4-4.19	Important	Critical Level
2.6-3.39	Moderate	Moderate Level
1.8-2.59	Less important	Low Level
1-1.79	Least important	Low Level

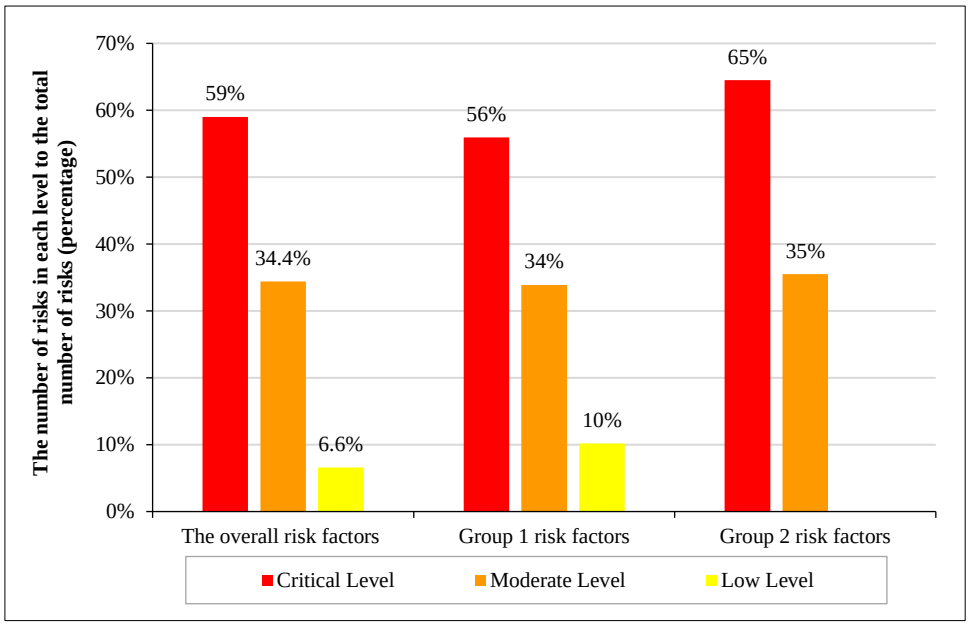

Figure 2. The level of importance distribution of overall, Group 1 and Group 2 risk factors as rated by the respondents

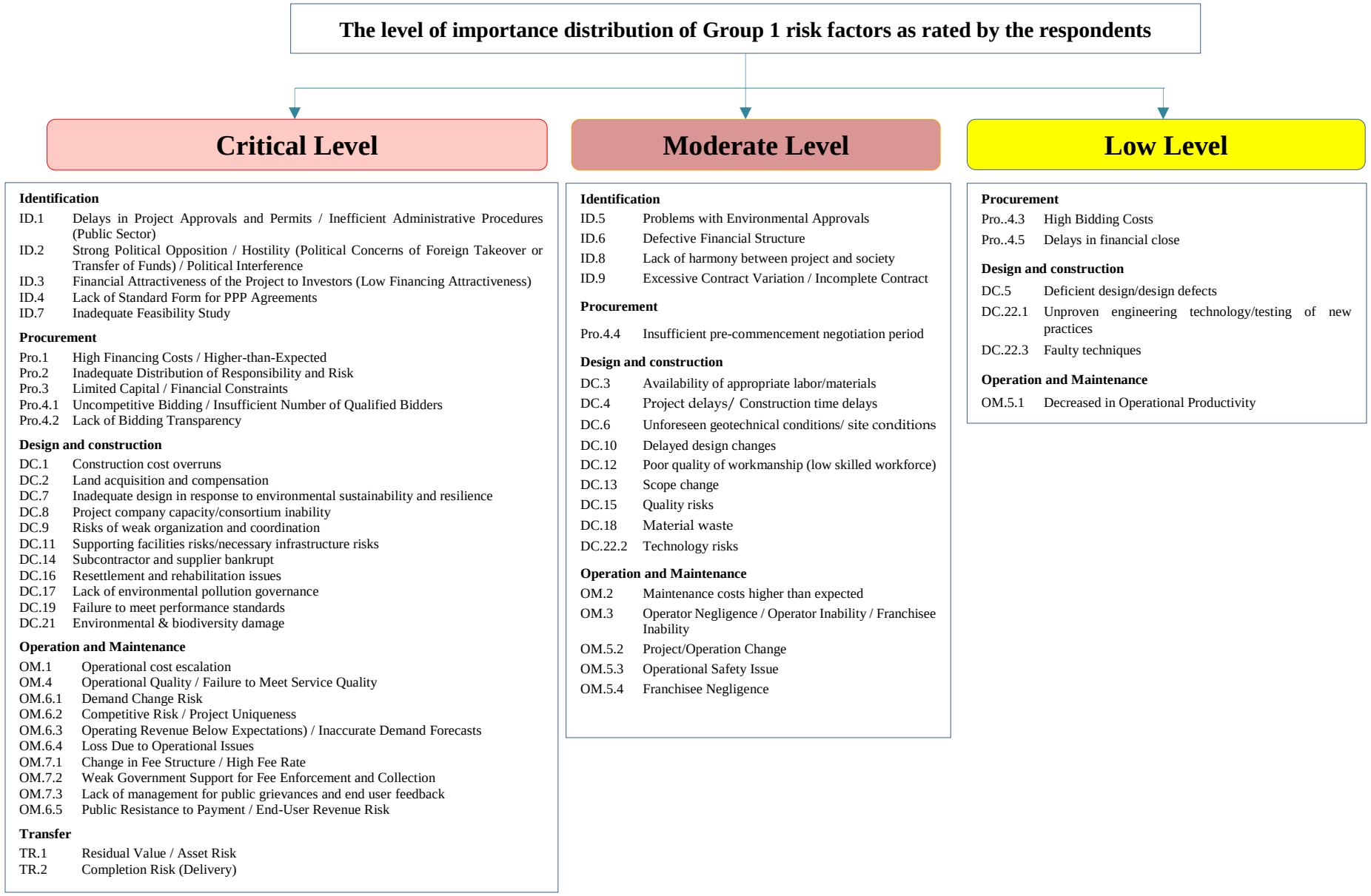

Figure 3. Presents lists of Group 1 risks according to their level of importance

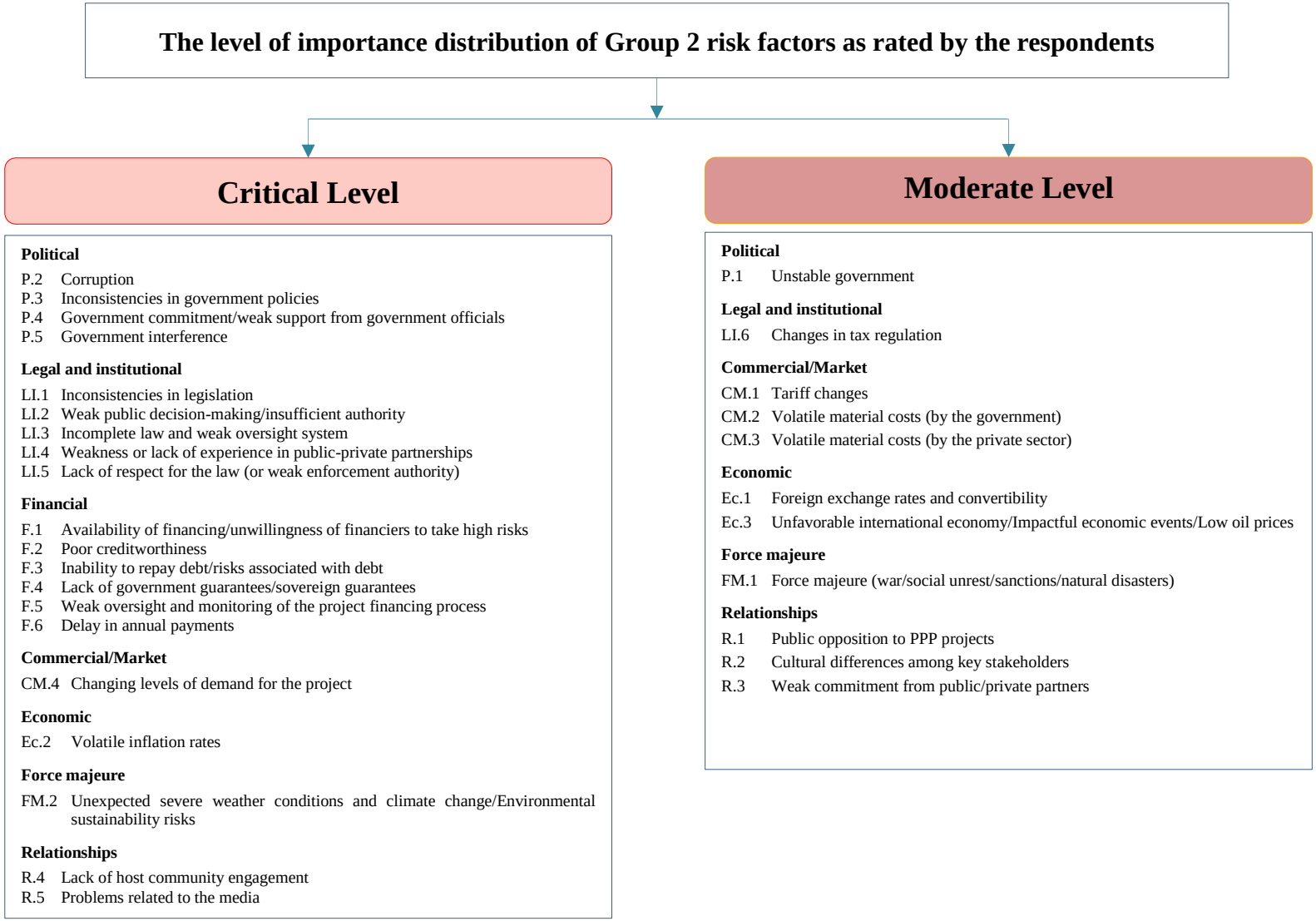

Figure 4. Presents lists of Group 2 risks according to their level of importance

4.2.1. Risks' Importance Ranking from the Standpoint of Overall Participants

Table 6 presents the top 10 risks from the standpoint of all participants. Figures 3 and 4 were developed based on the data presented in Table A1 in Appendix I to reflect the risk factor ratings from the standpoint of all participants. The findings indicate that:

- Financial and fiscal sustainability concerns form a serious challenge for PPP professionals. Four of the top critical-level risks are financial, as presented in Table 6. This is unsurprising, as financial sustainability reflects the ability of public entities to withstand the financial liabilities resulting from this type of long-term infrastructure development arrangement [54]. Furthermore, Figure 4 shows that all financial risk factors were rated at the critical level.
- The lack of a standard form for PPP agreements ranked second. Standardized PPP agreements enhance the replicability, scalability, and transparency of PPP projects [70]. Moreover, PPP programs aimed at achieving the SDGs must be replicable and scalable to generate the transformative impact mandated by the 2030 Agenda for Sustainable Development. This criterion also requires evaluating whether local personnel and governments have the necessary capacity or can obtain appropriate training and knowledge to undertake similar projects [26].
- From Table 6, it is worth noting that there is growing awareness of climate change and environmental sustainability risks, which ranked third. PPPs that support SDG attainment enhance the resilience of infrastructure projects and strengthen PPP practitioners' responsibilities toward environmental sustainability [70], alongside the adoption of the circular economy. The circular economy has the capacity to address climate change and other global challenges, such as biodiversity loss, waste, and pollution, by decoupling economic activity from the use of limited resources. It also facilitates the transition to renewable energy and materials, creating a resilient framework that benefits businesses, individuals, and the environment [98, 99].
- The lack of host community engagement, which ranked seventh, reflects a strong perception of its importance. Adopting stakeholder analysis and ensuring stakeholder involvement throughout all phases of PPP project development and implementation can significantly enhance project effectiveness [100]. Cheng et al. [101] identified that the development of the PPP approach has progressed through three stages. The driver of the first stage was to bridge the financing gap to achieve economic infrastructure by engaging private sector funding, based mainly on economic evaluation, with the public and private sectors as the primary contributors. In the second stage, the driver was improving the quality of public services to achieve social infrastructure, also based on economic evaluation, with the public and private sectors remaining the main contributors. In the third stage, attaining sustainable development became the driver, aiming to achieve environmentally friendly infrastructure based on comprehensive economic, social, and environmental evaluation. In this stage, the public—particularly host communities—plays a pivotal role, alongside the public and private sectors as key contributors.
- It is worth noting that risks affecting sustainable development outcomes in PPP infrastructure projects appear on the critical-level list. These include inadequate design in response to environmental sustainability and resilience, land acquisition and compensation issues, resettlement and rehabilitation challenges, lack of environmental pollution governance, environmental and biodiversity damage, and poor management of public grievances and end-user feedback, as presented in Figure 3. Moreover, it can be noted that:
    - The number of risks listed under the identification phase is nine. Of these, five were rated as critical and four as moderate. The critical risks with the highest ratings in this phase were delays in project approvals and permits, and poor feasibility study preparation, which is consistent with findings reported in [1, 44, 45].
    - The number of risks listed under the procurement phase is eight. Of these, five were rated as critical, one as moderate, and two as low. The critical risks with the highest ratings in this phase were higher-than-expected financing costs, inadequate allocation of responsibilities and risks, financial constraints, uncompetitive bidding or an insufficient number of qualified bidders, and lack of bidding transparency, which aligns with previous studies [1, 37, 44, 45, 46, 88].
    - The number of risks listed under the design and construction phase is 24. Among these, 11 were rated as critical, nine as moderate, and three as low. The highest-rated critical risks were construction cost overruns, land acquisition and compensation, and project company capacity or consortium inability, which is consistent with many earlier studies [1, 44, 45, 46, 88]. Additionally, risks such as inadequate design in response to environmental sustainability and resilience, resettlement and rehabilitation issues, lack of environmental pollution governance, failure to meet performance standards, and environmental and biodiversity damage were

highlighted in studies [35, 55–57]. Undoubtedly, this phase is particularly susceptible to risks due to its high demands and the influence of both natural and human factors [102].

- The number of risks listed under the operation and maintenance phase is 16. Of these, 10 were rated as critical, five as moderate, and one as low. The highest-rated critical risks included failure to meet service quality, weak government support for fee enforcement and collection, demand change risk, and competitive risk, which are consistent with findings from most previous studies [1, 44, 45, 46, 88]. Furthermore, the lack of management for public grievances and end-user feedback was also rated as critical, aligning with the People-First PPP approach for SDG development [70, 55].
- The number of risks listed under the transfer phase is two, and both were rated as critical. This finding is consistent with previous studies [45, 46, 88], where residual value risk and completion (delivery) risk are considered significant concerns for PPP practitioners [37, 85, 86].

- Figure 4 presents the list of risks according to their level of importance under Group 2 (risk factors that may be encountered at any time across the project life cycle). From this, it can be concluded that:
  - The number of risks listed under the political category is five. Of these, four were rated as critical and one as moderate. The critical risks with the highest ratings were corruption, inconsistencies in government policies, lack of government commitment, and government interference. Meanwhile, unstable government was rated as moderate, as the situation in Iraq is currently more stable. This is consistent with findings from most previous studies [1, 37, 44, 45, 46, 88].
  - The number of risks listed under the legal and institutional category is six. Of these, five were rated as critical and one as moderate. It is worth noting that weak public decision-making or insufficient authority, incomplete laws and weak oversight systems, weakness or lack of experience in public–private partnerships, and lack of respect for the law or weak enforcement authority received high rating values. This reflects consistency with [26, 103, 104], who suggested a comprehensive framework to support PPP for sustainable development.
  - The number of risks listed under the financial category is six, and all of them were rated as critical, with some of the highest rating values among all risks. These include the availability of financing or unwillingness of financiers to take high risks, poor creditworthiness, inability to repay debt or risks associated with debt, lack of government or sovereign guarantees, weak oversight and monitoring of the project financing process, and delays in annual payments. This is consistent with findings in [1, 35, 37, 44, 45, 88].
  - The number of risks listed under the commercial/market category is four. Three risks were rated as moderate: tariff changes, volatile material costs (by the government), and volatile material costs (by the private sector). Meanwhile, changing levels of demand for the project was rated as critical with a high rating value, similar to what has been identified in most previous studies [35, 37, 44, 45, 46].
  - The number of risks listed under the economic category is three. Two were rated as moderate, while inflation was rated as critical, which is consistent with other previous studies that have also identified inflation fluctuation as a critical risk [20, 35, 37].
  - The number of risks listed under the force majeure category is two. The risk related to climate change and environmental sustainability was rated as critical with a high rating value. On the other hand, other force majeure risks related to war, social unrest, sanctions, and natural disasters were rated as moderate. Mitigation and adaptation to climate change must be incorporated into PPP policies to mainstream climate change considerations at the national, sectoral, project, and local levels. This is a pivotal step in establishing a systematic institutional framework for climate change, enabling policymakers to employ country-specific climate change and disaster risk indices and screening tools to align sectoral infrastructure policies with the particular risks and impacts relevant to their geographic region. Adaptation refers to the effects of climate change on infrastructure assets and the measures that can be implemented to reduce their vulnerability and enhance their resilience, whereas mitigation involves strategies or actions aimed at eliminating or reducing greenhouse gas emissions, for example. The costs associated with adaptation measures during the early phases of an infrastructure project are minimal compared to the potential costs of reconstruction or repair [26]. A study in this regard conducted on roadway infrastructure projects demonstrates that proactive adaptation strategies result in lower fiscal expenditures and improved connectivity rates [105].

- Regarding relational risks, lack of host community engagement was rated as critical with a high rating value, as engagement can encourage the involvement of all stakeholders in developing a sound action plan that defines

desired objectives and outcomes and achieves agreement on mutual commitment to long-term development outcomes and the well-being of all involved parties [106]. Meanwhile, lack of transparency, absence of stakeholder analysis, and lack of host community involvement and engagement may lead to public opposition, social unrest, and demonstrations [107]. Therefore, engaging stakeholders in all phases of PPP project development and implementation will enable feedback throughout the process. In addition, PPP projects derive legitimacy and validity from political commitment and public acceptance, ultimately improving PPP implementation. Stakeholder engagement across all phases can also reduce other critical risk factors identified by respondents, such as public opposition and media-related problems. It is worth noting that weak commitment from public or private partners was rated as moderate, which is inconsistent with previous studies that identified it as critical [44–46].

Table 6. Top 10 risks from standpoint of overall participants

Rank	Risk Type	Code	Overall respondents
1	Financial	F.1	Availability of financing/unwillingness of financiers to take high risks
2	Identification	ID.4	Lack of Standard Form for PPP Agreements
3	Force majeure	FM.2	Unexpected severe weather conditions and climate change/Environmental sustainability risks
4	Financial	F.4	Lack of government guarantees/sovereign guarantees
5	Design and construction	DC.8	Project company capacity/consortium inability
6	Transfer	TR.2	Completion Risk (Delivery)
7	Relationships	R.4	Lack of host community engagement
8	Financial	F.6	Delay in annual payments
9	Operation and Maintenance	OM.4	Operational Quality / Failure to Meet Service Quality
10	Financial	F.2	Poor creditworthiness

4.2.2. Test Internal Consistency in Each Sector's Group

To test internal consistency, Kendall's $\mathcal{W}$ coefficient was applied. The hypotheses are as follows: the null hypothesis, where H_0 : $\mathcal{W}$ equals zero, and the alternative hypothesis, where H_0 : $\mathcal{W}$ does not equal zero. Since the number of risks to be tested is 90, which is greater than 7, the Chi-square value is adopted instead of the $\mathcal{W}$ value. Table 7 presents the results of Kendall's W test on risk rank ratings. It shows that the critical Chi-square value for both sectors is 101.879 at degrees of freedom (df) equal to $n-1$. Meanwhile, the Chi-square values for both sectors obtained through SPSS are greater than the critical value, reflecting agreement among the participants within each sector group.

Table 7. Kendall's W test results on risks rank rating

Item	Public sector	Private sector
Number of survey respondents	35	17
Kendall's $\mathcal{W}$	0.499	0.502
df	89	89
Asymp. Sig.	<0.001	<0.001
Chi-Square	1552.844	759.022
Critical value Chi-square	101.879	101.879

4.2.3. Test Internal Consistency among Both Sector's Group

To test internal consistency among all participants in the two survey groups, the Kruskal–Wallis test was applied. The null hypothesis states that the median significance value for each risk factor is equal across both sector groups. Table 8 presents the test results obtained through SPSS, where the Chi-square value represents H and "Asymp. Sig." represents the P-value, since the number of participants in each group is greater than five. This indicates the probability of obtaining a given H value equivalent to the Chi-square value relative to the P-value, with degrees of freedom (df) equal to $n-1$. The results reveal that the P-value is greater than 0.05; therefore, the null hypothesis is accepted, indicating agreement between the two survey groups in rating the importance of the risks.

Table 8. Kruskal Wallis test for inner agreement among survey groups

Code	Kruskal-Wallis H	df	Asymp. Sig.	Code	Kruskal-Wallis H	df	Asymp. Sig.
ID.1	0.145	1	0.703	OM.5.1	0.192	1	0.661
ID.2	0.003	1	0.954	OM.5.2	0.146	1	0.702
ID.3	0.13	1	0.719	OM.5.3	0.121	1	0.728
ID.4	1.718	1	0.19	OM.5.4	0.192	1	0.661
ID.5	0.105	1	0.746	OM.6.1	0.619	1	0.431
ID.6	0.099	1	0.753	OM.6.2	0.458	1	0.498
ID.7	0.009	1	0.926	OM.6.3	0.612	1	0.434
ID.8	0.176	1	0.675	OM.6.4	0.183	1	0.669
ID.9	0.001	1	0.975	OM.6.5	0.183	1	0.669
Pro.1	0.627	1	0.429	OM.7.1	0.458	1	0.498
Pro.2	0.189	1	0.664	OM.7.2	0.81	1	0.368
Pro.3	0.139	1	0.709	OM.7.3	0.096	1	0.757
Pro.4.1	0.544	1	0.461	TR.1	2.206	1	0.137
Pro.4.2	0.81	1	0.368	TR.2	1.6	1	0.206
Pro..4.3	1.622	1	0.203	P.1	0.133	1	0.716
Pro.4.4	0.189	1	0.664	P.2	0.81	1	0.368
Pro..4.5	1.622	1	0.203	P.3	0.81	1	0.368
DC.1	0.491	1	0.484	P.4	0.81	1	0.368
DC.2	0.104	1	0.747	P.5	0.81	1	0.368
DC.3	0.253	1	0.615	LI.1	0.384	1	0.536
DC.4	0.809	1	0.369	LI.2	0.81	1	0.368
DC.5	0.048	1	0.827	LI.3	0.458	1	0.498
DC.6	0.006	1	0.941	LI.4	0.147	1	0.701
DC.7	0.031	1	0.861	LI.5	0.81	1	0.368
DC.8	0.01	1	0.919	LI.6	0.209	1	0.648
DC.9	0.031	1	0.861	F.1	0.81	1	0.368
DC.10	0.346	1	0.557	F.2	0.084	1	0.772
DC.11	0.004	1	0.922	F.3	0.36	1	0.548
DC.12	0.146	1	0.702	F.4	0.006	1	0.936
DC.13	0.277	1	0.599	F.5	0.084	1	0.772
DC.14	0.006	1	0.936	F.6	1.176	1	0.278
DC.15	0.114	1	0.735	CM.1	0.346	1	0.557
DC.16	0.121	1	0.728	CM.2	0.003	1	0.958
DC.17	1.114	1	0.291	CM.3	1.211	1	0.271
DC.18	0.048	1	0.827	CM.4	0.72	1	0.396
DC.19	1.114	1	0.291	Ec.1	2.064	1	0.151
DC.20	0.002	1	0.966	Ec.2	0.029	1	0.864
DC.21	0.501	1	0.479	Ec.3	0.341	1	0.559
DC.22.1	0.033	1	0.856	FM.1	0.039	1	0.844
DC.22.2	1.114	1	0.291	FM.2	0.458	1	0.498
DC.22.3	2.206	1	0.137	R.1	0.373	1	0.542
OM.1	0.371	1	0.542	R.2	0.001	1	0.975
OM.2	0.137	1	0.711	R.3	0.183	1	0.669
OM.3	0.557	1	0.455	R.4	1.114	1	0.291
OM.4	0.007	1	0.932	R.5	1.718	1	0.19

5. Conclusion

As all legal and institutional risks have been rated as critical risk factors (except changes in tax regulations) with high rating values, this asserts the urgent need to legislate a PPP law and develop a comprehensive framework that enables public authorities to develop, manage, assess, monitor, and govern PPP projects, with a focus on safeguarding citizens, well-being, and sustainable development. Moreover, it is necessary to develop a financial management framework in Iraq to support the PPP approach and ensure its financial and fiscal sustainability, since financial and fiscal sustainability concerns form a serious challenge for PPP professionals, as four of the top ten critical risk factors are financial. In addition, all financial risk factors have been rated as critical. As the risk factors that affect sustainable development outcomes in PPP infrastructure projects are also listed at a critical level, it is recommended to adopt a circular economy approach to mitigate their impact. It is further recommended that the circular economy concept be explicitly stated in the proposed Iraqi PPP law. Additionally, PPP contract agreements should be carefully designed to ensure that sustainable development outcomes are clearly defined, including improved affordability and access, enhanced equity and social justice, and environmental sustainability and resilience. Altogether, these measures may make PPPs more effective in achieving desirable outcomes for all stakeholders involved in the partnership.

Furthermore, reforming and standardizing approval procedures, delegating authority where needed, and enhancing interagency coordination are essential for improving time efficiency and facilitating the implementation of the PPP approach. Finally, the identified risk factors indicate that strong government commitment is crucial to provide the necessary support for enhancing the investment environment.

5.1. Research Limitations

As the PPP approach and the concept of sustainable development have only recently been practiced in Iraq, experience in this field remains limited. Accordingly, the opinions presented by the participants in this paper may be subject to bias. Despite this, the study has achieved its objective.

6. Declarations

6.1. Author Contributions

Conceptualization, J.H. and A.M.; methodology, J.H.; formal analysis, J.H.; investigation, J.H.; resources, J.H.; data curation, J.H.; writing—original draft preparation, J.H.; writing—review and editing, J.H.; supervision, A.M. All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

6.3. Funding

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6.4. Acknowledgments

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6.5. Conflicts of Interest

The authors declare no conflict of interest.

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Appendix I

Table A1. Risk factors obtained from previous studies

#	Individual Risk Factors	Frequency	Weight %
1	Delay in project approvals and permits / Insufficient public administration processes	16	2.65
2	Interest rate volatility	15	2.48
3	Change in law /Legal change	14	2.32
4	Construction cost overruns	14	2.32
5	Land acquisition/ Site availability	13	2.15
6	Excessive contract variation/ Imperfect contract risk	13	2.15
7	Inflation rate volatility	13	2.15
8	Poor public decision making process/ Insufficient authority	12	1.99
9	Availability of appropriate labor/material	12	1.99
10	Construction time delay /Project delay / Inappropriate schedule	12	1.99
11	Force majeure (War/ Social unrest /Sanction)	12	1.99
12	Expropriation/nationalization of assets	11	1.82
13	Design deficiency/ Design flaws	11	1.82
14	Geotechnical conditions/ground condition	11	1.82
15	Foreign exchange and convertibility	11	1.82
16	Operation and maintenance cost overrun/ Escalation	11	1.82
17	Public opposition to projects/Swings in public opinion	11	1.82
18	Environmental sustainability risk	11	1.82
19	Corruption	10	1.66
20	Change in taxes regulation	10	1.66
21	Demand change risk	10	1.66
22	Poor organization and coordination risk	10	1.66
23	Strong political opposition/hostility (Political concerns of foreign takeover or transfer of fund)/ Political interference	9	1.49
24	Residual value (after concession period) / asset risk	9	1.49
25	Unforeseen sever weather conditions and climate change	9	1.49
26	Unstable government	8	1.32
27	Availability of finance	8	1.32
28	Legislation change/inconsistencies	8	1.32
29	Tariff change	8	1.32
30	Inadequate experience in PPP	8	1.32
31	Financial attraction of project to investors (Low attraction of funding)	8	1.32
32	Higher than expected finance costs / High finance cost	8	1.32
33	Inadequate design in response to environmental sustainability and resilience	7	1.16
34	Contractor failure / Capability of SPV	7	1.16
35	Lack of environmental pollution governance	7	1.16
36	Maintenance cost higher than expected	7	1.16
37	Different working methods/know-how between partners	7	1.16
38	Lack of commitment from public/private partner	7	1.16
39	Inconsistencies in government policies	6	0.99
40	lack of respect for law (or lack of law enforcement)	6	0.99
41	Industrial regulatory change Import/export restrictions	6	0.99
42	Non-competitive tender /Lack of enough qualified bidders	6	0.99
43	Competition risk / Project Uniqueness	6	0.99
44	Inability of concessionaire/ Operator default /Operator inability	6	0.99
45	Government reliability /Lack of support from government officials	5	0.83
46	Completion (handling over) risk	5	0.83
47	Unproven engineering technique / Testing new practices	5	0.83
48	Poor quality of workmanship	5	0.83
49	Change of scope	5	0.83
50	Late design changes	5	0.83
51	Operation financial risk (operational revenue below expectation)	5	0.83
52	Low operating productivity / Low productivity	5	0.83
53	Supporting facilities risk/necessary infrastructure risk	5	0.83
54	Third party tort liability	5	0.83
55	Inadequate distribution of responsibility and risk	5	0.83

56	Government intervention	4	0.66
57	Consortium inability	4	0.66
58	Insolvency/default of subcontractors and suppliers	4	0.66
59	Poor financial market	4	0.66
60	Fluctuation of material cost (by government)	4	0.66
61	Fluctuation of material cost (by private)	4	0.66
62	Level of demand for the project	4	0.66
63	Contractual dispute /Litigation or inordinate	4	0.66
64	Quality risk	3	0.5
65	Lack of a standard model for PPP agreements	3	0.5
66	Problems related to construction safety	3	0.5
67	Lack of transparency in bidding / Insufficient bidding process	3	0.5
68	Unfavourable international economy /Influential Economic events (decline in oil price)	3	0.5
69	Risk regarding pricing of product/service	3	0.5
70	Quality of operation / Failure to meet service quality	3	0.5
71	Project/operation changes	3	0.5
72	Technology risk	3	0.5
73	Staff internal crisis	3	0.5
74	Lack of creditworthiness	3	0.5
75	Limited capital / Financial constraints	3	0.5
76	High bidding costs / High tendering cost	3	0.5
77	Unexpected site conditions	2	0.33
78	Problems with resettlement and rehabilitation	2	0.33
79	Inadequate law and supervision system/Imperfect law and supervision system	2	0.33
80	Problem related to operation safety	2	0.33
81	Price / Fee / Toll change	2	0.33
82	Inadequate negotiation period prior to initiation	2	0.33
83	Cultural differences between main stakeholders /Problems related to partnership	2	0.33
84	Delay in financial closure	2	0.33
85	Inability to service debt / Risks associated with debt	2	0.33
86	Problems related to financing methods and supply	2	0.33
87	Lack of government guarantees / lack of sovereign guarantee	2	0.33
88	Lack of management for public grievances and end user feedback	2	0.33
89	Natural Disaster	2	0.33
90	Delay in payment of annuity	2	0.33
91	Failure to meet performance criteria	1	0.17
92	Environmental & biodiversity damage	1	0.17
93	Damage to Project structures, construction equipment, labour ...	1	0.17
94	Faulty techniques	1	0.17
95	Problems with construction logistics	1	0.17
96	Rate of returns restrictions	1	0.17
97	Inadequate government supports for fee enforcement	1	0.17
98	Negligence of operation by concessionaire	1	0.17
99	Waste of material	1	0.17
100	Faulty financial structure	1	0.17
101	Unclear project objectives	1	0.17
102	Inadequate feasibility study	1	0.17
103	Problems with environmental approvals	1	0.17
104	Subjective project evaluation method	1	0.17
105	Non -involvement of host-community	1	0.17
106	Problems related to Media	1	0.17
107	Financiers unwilling to take high risk	1	0.17
108	Low demand	1	0.17
109	Inaccurate demand forecasts	1	0.17
110	Loss due to operational problems	1	0.17
111	Alteration in toll /fee structure	1	0.17
112	High tolling/ Fee rate	1	0.17
113	Lack of harmony between project and society	1	0.17
114	Insufficient project finance supervision	1	0.17
115	Lack of cash flow	1	0.17
116	Project / Facility/ service quality deterioration	1	0.17
	Total	**604**	100

Table A2. Risks importance ranking as rated by the survey respondents

Risk Factors	Public					Private				Overall			
	Code	M	SD	Mean Rank	Rank	M	SD	Mean Rank	Rank	Mean	SD	Mean Rank	Rank
Risk Factors that may appear within specific phases of the project life cycle (Group 1)													
Identification													
Delays in Project Approvals and Permits / Inefficient Administrative Procedures (Public Sector)	ID.1	3.51	0.818	44.31	**47**	3.47	0.874	44.68	**48**	3.50	0.828	44.43	**48**
Strong Political Opposition / Hostility (Political Concerns of Foreign Takeover or Transfer of Funds) / Political Interference	ID.2	3.51	1.067	44.66	**46**	3.47	0.874	44.68	**49**	3.50	1.000	44.66	**46**
Financial Attractiveness of the Project to Investors (Low Financing Attractiveness)	ID.3	3.69	0.932	48.20	**39**	3.82	0.809	52.44	**36**	3.73	0.888	49.59	**36**
Lack of Standard Form for PPP Agreements	ID.4	4.80	0.406	73.50	**3**	4.94	0.243	78.53	**1**	4.85	0.364	75.14	**2**
Problems with Environmental Approvals	ID.5	2.91	1.197	32.39	**70**	3.06	1.088	35.71	**61**	2.96	1.154	33.47	**67**
Defective Financial Structure	ID.6	2.86	1.033	29.57	**74**	2.94	1.088	32.91	**69**	2.88	1.041	30.66	**71**
Inadequate Feasibility Study	ID.7	3.91	0.853	57.86	**28**	3.88	0.781	59.91	**23**	3.90	0.823	58.53	**27**
Lack of harmony between project and society	ID.8	3.09	1.502	35.51	**61**	2.82	1.704	31.56	**71**	3.00	1.559	34.22	**64**
Excessive Contract Variation / Incomplete Contract	ID.9	3.03	1.723	43.07	**51**	3.12	1.654	47.41	**41**	3.06	1.685	44.49	**47**
Procurement													
Higher-than-Expected Financing Costs / High Financing Costs	Pro.1	3.69	1.430	48.83	**36**	3.94	1.478	56.26	**29**	3.77	1.436	51.26	**34**
Inadequate Distribution of Responsibility and Risk	Pro.2	3.54	1.039	41.44	**54**	3.35	1.222	37.03	**56**	3.48	1.093	40.00	**54**
Limited Capital / Financial Constraints	Pro.3	3.66	0.765	46.70	**44**	3.71	0.686	48.15	**40**	3.67	0.734	47.17	**44**
Bidding Risks													
Uncompetitive Bidding / Insufficient Number of Qualified Bidders	Pro.4.1	4.20	0.868	59.03	**26**	4.00	0.935	54.88	**31**	4.13	0.886	57.67	**29**
Lack of Bidding Transparency / Poor Bidding Process	Pro.4.2	4.14	1.375	54.94	**32**	3.76	1.522	46.18	**43**	4.02	1.421	52.08	**33**
High Bidding Costs	Pro.4.3	2.23	1.060	14.17	**88**	2.53	1.179	18.71	**85**	2.33	1.098	15.65	**86**
Insufficient pre-commencement negotiation period	Pro.4.4	2.94	0.873	27.66	**76**	2.94	1.088	27.76	**76**	2.94	0.938	27.69	**76**
Delays in financial close	Pro.4.5	2.23	1.060	14.17	**89**	2.53	1.179	18.71	**86**	2.33	1.098	15.65	**87**
Design and construction													
Construction cost overruns	DC.1	3.71	0.622	48.07	**40**	3.59	0.618	45.44	**44**	3.67	0.617	47.21	**43**
Land acquisition and compensation/site availability	DC.2	4.23	0.877	60.07	**25**	4.12	0.993	59.18	**24**	4.19	0.908	59.78	**25**
Availability of appropriate labor/materials	DC.3	2.83	0.923	28.60	**75**	3.00	1.061	34.21	**67**	2.88	0.963	30.43	**75**
Project delays/ Construction time delays	DC.4	2.89	0.796	25.97	**79**	2.71	0.772	20.82	**84**	2.83	0.785	24.29	**82**
Deficient design/design defects	DC.5	2.37	0.877	15.06	**87**	2.35	0.786	13.06	**88**	2.37	0.841	14.40	**88**
Unforeseen geotechnical conditions/site conditions	DC.6	3.20	1.079	33.36	**68**	3.18	1.074	31.24	**72**	3.19	1.067	32.66	**70**
Inadequate design in response to environmental sustainability and resilience	DC.7	3.86	1.309	52.41	**33**	3.94	1.249	55.88	**30**	3.88	1.278	53.55	**32**
Project company capacity/consortium inability	DC.8	4.51	0.507	70.64	**6**	4.53	0.514	74.41	**4**	4.52	0.505	71.88	**5**
Risks of weak organization and coordination	DC.9	3.69	0.631	47.40	**41**	3.65	0.606	46.94	**42**	3.67	0.617	47.25	**42**
Delayed design changes	DC.10	3.03	0.857	33.86	**65**	3.12	0.781	35.88	**60**	3.06	0.826	34.52	**63**
Supporting facilities risks/necessary infrastructure risks	DC.11	3.60	0.651	45.21	**45**	3.59	0.618	45.44	**45**	3.60	0.634	45.29	**45**
Poor quality of workmanship (low skilled workforce)	DC.12	2.60	0.976	24.30	**81**	2.65	0.862	25.47	**81**	2.62	0.932	24.68	**80**
Scope change	DC.13	3.20	0.584	36.47	**58**	3.24	0.562	37.68	**54**	3.21	0.572	36.87	**58**
Subcontractor and supplier bankruptcies/defaults	DC.14	4.20	0.994	58.97	**27**	4.18	1.015	60.38	**15**	4.19	0.991	59.43	**26**
Quality risks	DC.15	3.17	0.568	35.83	**60**	3.12	0.485	35.03	**65**	3.15	0.538	35.57	**60**
Resettlement and rehabilitation issues	DC.16	3.60	0.651	49.90	**34**	3.65	0.606	52.91	**33**	3.62	0.631	50.88	**35**
Lack of environmental pollution governance	DC.17	3.49	0.658	47.04	**42**	3.65	0.606	52.91	**34**	3.54	0.641	48.96	**39**
Material waste	DC.18	3.29	0.622	38.66	**56**	3.29	0.588	39.18	**53**	3.29	0.605	38.83	**55**
Failure to meet performance standards	DC.19	3.49	0.658	47.04	**43**	3.65	0.606	52.91	**35**	3.54	0.641	48.96	**40**
Construction logistics issues	DC.20	2.94	1.056	30.86	**72**	2.88	0.928	29.97	**73**	2.92	1.007	30.57	**72**
Environmental & biodiversity damage	DC.21	3.49	0.658	42.76	**52**	3.59	0.618	45.44	**46**	3.52	0.641	43.63	**49**

Risk Factors		Public				Private				Overall			
	Code	M	SD	Mean Rank	Rank	M	SD	Mean Rank	Rank	Mean	SD	Mean Rank	Rank
Technological risks													
Unproven engineering technology/testing of new practices	DC.22.1	2.54	0.886	19.21	**85**	2.53	0.800	18.53	**87**	2.54	0.851	18.99	**85**
Technology risks	DC.22.2	2.57	0.884	23.03	**83**	2.71	0.772	25.97	**79**	2.62	0.844	23.99	**83**
Faulty techniques	DC.22.3	2.03	1.014	10.99	**90**	2.18	0.728	10.76	**90**	2.08	0.926	10.91	**90**
Operation and Maintenance													
Operational cost escalation	OM.1	4.06	0.968	55.53	**30**	3.88	0.993	52.24	**37**	4.00	0.970	54.45	**31**
Maintenance costs higher than expected	OM.2	3.14	0.733	36.01	**59**	3.18	0.529	36.53	**58**	3.15	0.668	36.18	**59**
Operator Negligence / Operator Inability / Franchisee Inability	OM.3	3.06	0.684	33.83	**66**	3.12	0.485	35.03	**66**	3.08	0.621	34.22	**65**
Operational Quality / Failure to Meet Service Quality	OM.4	4.29	0.789	64.56	**16**	4.35	0.606	68.62	**8**	4.31	0.729	65.88	**9**
Operational Issues													
Decreased Operational Productivity	OM.5.1	2.40	0.881	15.17	**86**	2.29	0.772	11.76	**89**	2.37	0.841	14.06	**89**
Project/Operation Change	OM.5.2	2.60	0.976	24.30	**82**	2.65	0.862	25.47	**82**	2.62	0.932	24.68	**81**
Operational Safety Issue	OM.5.3	2.69	0.867	25.03	**80**	2.71	0.772	25.97	**80**	2.69	0.829	25.34	**79**
Franchisee Negligence	OM.5.4	3.31	0.631	39.33	**55**	3.24	0.562	37.68	**55**	3.29	0.605	38.79	**56**
Revenue Risk													
Demand Change Risk	OM.6.1	4.34	0.906	63.04	**20**	4.12	0.993	59.18	**25**	4.27	0.931	61.78	**20**
Competitive Risk / Project Uniqueness	OM.6.2	4.26	0.980	60.86	**22**	4.06	1.029	57.68	**26**	4.19	0.991	59.82	**22**
Financial Operational Risk (Operating Revenue Below Expectations) / Declining Demand / Inaccurate Demand Forecasts	OM.6.3	3.57	1.145	42.23	**53**	3.29	1.213	35.53	**62**	3.48	1.163	40.04	**53**
Loss Due to Operational Issues	OM.6.4	3.46	0.852	43.34	**48**	3.35	0.786	41.97	**50**	3.42	0.825	42.89	**50**
Public Resistance to Payment / End-User Revenue Risk	OM.6.5	3.46	0.852	43.34	**49**	3.35	0.786	41.97	**51**	3.42	0.825	42.89	**51**
Fees Risk													
Change in Fee Structure / High Fee Rate	OM.7.1	4.26	0.980	60.86	**23**	4.06	1.029	57.68	**27**	4.19	0.991	59.82	**23**
Weak Government Support for Fee Enforcement and Collection	OM.7.2	4.43	0.917	64.80	**9**	4.18	1.015	60.38	**16**	4.35	0.947	63.36	**12**
Lack of management for public grievances and end user feedback	OM.7.3	3.74	0.657	49.11	**35**	3.71	0.772	49.74	**39**	3.73	0.689	49.32	**38**
Transfer / Transfer of Ownership													
Residual Value (After the Concession Period) / Asset Risk	TR.1	3.86	0.550	55.51	**31**	4.06	0.243	62.18	**12**	3.92	0.479	57.69	**28**
Completion Risk (Delivery)	TR.2	4.60	0.497	72.57	**4**	4.41	0.507	70.12	**7**	4.54	0.503	71.77	**6**
Risk Factors that may appear across the project life cycle (Group 2)													
Political													
Unstable government	P.1	2.69	1.078	26.91	**77**	2.53	0.874	24.47	**83**	2.63	1.010	26.12	**78**
Corruption	P.2	4.43	0.917	64.80	**10**	4.18	1.015	60.38	**17**	4.35	0.947	63.36	**13**
Inconsistencies in government policies	P.3	4.43	0.917	64.80	**11**	4.18	1.015	60.38	**18**	4.35	0.947	63.36	**14**
Government commitment/weak support from government officials	P.4	4.43	0.917	64.80	**12**	4.18	1.015	60.38	**19**	4.35	0.947	63.36	**15**
Government interference	P.5	4.43	0.917	64.80	**13**	4.18	1.015	60.38	**20**	4.35	0.947	63.36	**16**
Legal and institutional													
Inconsistencies in legislation	LI.1	4.11	0.932	57.47	**29**	3.94	0.966	53.38	**32**	4.06	0.938	56.13	**30**
Weak public decision-making/insufficient authority	LI.2	4.43	0.917	64.80	**14**	4.18	1.015	60.38	**21**	4.35	0.947	63.36	**17**
Incomplete law and weak oversight system	LI.3	4.26	0.980	60.86	**24**	4.06	1.029	57.68	**28**	4.19	0.991	59.82	**24**
Weakness or lack of experience in public-private partnerships	LI.4	3.71	0.789	48.59	**37**	3.59	0.618	45.44	**47**	3.67	0.734	47.56	**41**
Lack of respect for the law (or weak enforcement authority)	LI.5	4.43	0.917	64.80	**15**	4.18	1.015	60.38	**22**	4.35	0.947	63.36	**18**
Changes in tax regulation	LI.6	3.09	1.147	34.93	**63**	2.82	0.809	28.76	**74**	3.00	1.048	32.91	**69**

Risk Factors	Public					Private				Overall			
	Code	M	SD	Mean Rank	Rank	M	SD	Mean Rank	Rank	Mean	SD	Mean Rank	Rank
Financial													
Availability of financing/unwillingness of financiers to take high risks	F.1	4.71	0.458	75.37	**1**	4.59	0.507	75.62	**2**	4.67	0.474	75.45	**1**
Poor creditworthiness	F.2	4.20	0.406	63.63	**18**	4.24	0.437	67.68	**10**	4.21	0.412	64.95	**10**
Inability to repay debt/risks associated with debt	F.3	3.49	0.781	43.27	**50**	3.35	0.702	40.38	**52**	3.44	0.752	42.33	**52**
Lack of government guarantees/sovereign guarantees	F.4	4.6	0.497	72.40	**5**	5	0.507	75.62	**3**	4.60	0.50	73.45	**4**
Weak oversight and monitoring of the project financing process	F.5	4.20	0.406	63.63	**19**	4.24	0.437	67.68	**11**	4.21	0.412	64.95	**11**
Delay in annual payments	F.6	4.49	0.507	66.49	**8**	4.65	0.493	71.79	**6**	4.54	0.503	68.22	**8**
Commercial/Market													
Tariff changes	CM.1	3.11	0.676	34.59	**64**	3.18	0.636	36.38	**59**	3.13	0.658	35.17	**62**
Volatile material costs (by the government)	CM.2	2.94	1.162	31.50	**71**	2.82	0.883	28.62	**75**	2.90	1.071	30.56	**73**
Volatile material costs (by the private sector)	CM.3	2.60	0.695	21.74	**84**	2.82	0.728	27.29	**77**	2.67	0.706	23.56	**84**
Changing levels of demand for the project	CM.4	4.11	0.530	61.61	**21**	4.00	0.354	60.68	**14**	4.08	0.479	61.31	**21**
Economic													
Foreign exchange rates and convertibility	Ec.1	2.89	0.323	29.71	**73**	3.00	0.000	32.21	**70**	2.92	0.269	30.53	**74**
Volatile inflation rates	Ec.2	3.71	0.667	48.44	**38**	3.76	0.752	51.24	**38**	3.73	0.689	49.36	**37**
Unfavorable international economy/Impactful economic events/Low oil prices	Ec.3	3.31	0.471	37.70	**57**	3.24	0.437	36.56	**57**	3.29	0.457	37.33	**57**
Force majeure													
Force majeure (war/social unrest/sanctions/natural disasters)	FM.1	3.14	0.550	33.63	**67**	3.12	0.485	33.76	**68**	3.13	0.525	33.67	**66**
Unexpected severe weather conditions and climate change/Environmental sustainability risks	FM.2	4.63	0.490	73.61	**2**	4.53	0.514	74.41	**5**	4.60	0.495	73.88	**3**
Relationships													
Public opposition to PPP projects	R.1	3.11	0.323	32.66	**69**	3.18	0.393	35.06	**63**	3.13	0.345	33.44	**68**
Cultural differences Among key stakeholders	R.2	2.83	0.785	26.60	**78**	2.82	0.728	27.29	**78**	2.83	0.760	26.83	**77**
Weak commitment from public/private partners	R.3	3.23	0.426	35.51	**62**	3.18	0.393	35.06	**64**	3.21	0.412	35.37	**61**
Lack of host community engagement	R.4	4.51	0.658	70.39	**7**	4.35	0.606	68.62	**9**	4.46	0.641	69.81	**7**
Problems related to the media	R.5	4.20	0.406	63.80	**17**	4.06	0.243	62.18	**13**	4.15	0.364	63.27	**19**