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Information Requirements for Effective Risk and Contract Management in Public-Private Partnerships: A Delphi Approach

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ABSTRACT

Effective risk and contract management are crucial in Public-Private Partnerships (PPPs) and require adequate collection and utilisation of the project and financial information. Although access to sufficient information is indispensable, there is a lack of empirical literature documenting the information requirements in PPPs. This research aims to identify the information items the public party needs for effective risk and contract management in PPP projects undertaken in the construction sector. Information requirements were determined in three steps including (1) a structured literature review to identify the information items from academic studies, (2) identification of the information items currently used in the industry via expert interviews, and (3) validation of the information items via the Delphi Method, which included three rounds of consultations with 12 PPP experts. The findings present 52 qualitative project information requirements under various categories. In addition, 33 quantitative financial items were determined as essential information requirements for effective risk and contract management. The proposed information requirements were utilized to develop a qualitative risk assessment tool for the public party and its consultants to streamline structured data collection, avoid overlooking important project and financial information in risk assessment, and facilitate knowledge management in PPPs. The developed tool was tested by 21 PPP experts and found usable as a customizable knowledge-based system for qualitative risk assessment utilizing extensive project information during early risk assessment, feasibility studies, contract drafting and management in PPPs.

1.0 INTRODUCTION

A public-private partnership (PPP) is a long-term contractual arrangement between a Public Party, comprising governments and public sector organisations, and a Private Party to deliver a project or a service (Bovaird, 2004). Private partners can be responsible for various aspects, including design, financing, construction, operation, and maintenance of assets on behalf of the Public Party (OECD, 2012). The success of a PPP is closely tied to effective risk and contract management since PPPs include multiple contracts posing various risks as a project delivery and a project finance model (Kuru & Artan, 2020). Proper risk allocation between the parties and detailing the significant aspects of the project within the contracts requires adequate collection and utilisation of the PPP project and financial information. Therefore, identifying the essential PPP information items and integrating them into the contracts and project information systems have remarkable importance. The literature demonstrates unsuccessful PPP applications due to poor information management. For instance, in China, PPPs are frequently employed; however, due to the inadequacy of information systems, successful projects are rare (Huang et al., 2022). Despite the exigency, a detailed list of information items required for effective risk and contract management is currently unavailable in the PPP literature.

According to Boyce et al. (2017), "information" lacks a universally accepted definition but is generally understood as valuable, evaluated, and validated data. The Project Management Institute (PMI, 2016) defines "requirements" as "conditions or capabilities necessary in a product, service, or result" and highlights their role in meeting contractual or specification obligations. Information requirements encompass the data sources and information needs specified in contracts or specifications, and these are vital for developing products, services, or results. Information requirements can be applied to various programmes and projects and are adaptable to life cycle approaches (PMI, 2016). The structured collection and utilisation of project and financial information can also contribute to knowledge management (KM) in PPPs. Through knowledge sharing between the PPP projects, lessons learned in contract management and risk management in one PPP project can be transferred as valuable knowledge to other projects, which contributes to better risk and contract management in subsequent PPP projects via knowledge accumulated at the company and industry levels. Darroch and McNaughton (2022) underline the role of KM in creating or acquiring knowledge and managing its flow. Love et al. (2016) emphasises the need to draw on lessons from the experiences of individuals, teams, and organisations in construction projects to enhance performance and productivity. Knowledge transfer is also valuable for capacity building in PPPs (Chileshe et al., 2023). Consequently, information requirements can serve as a facilitator for managing and transferring knowledge within a PPP project or across different PPP projects, enabling more effective risk and contract management. In all this regard, the research question that guides this study is, "What are the information items that should be assessed/analysed by the Public Party in PPP projects?" This particular focus has been chosen due to the lack of comprehensive studies in the academic literature that directly address the information requirements in PPPs.

This study aims to establish a validated list of information items the Public Party requires for effective risk and contract management in PPP projects undertaken in the construction sector. Information items play a pivotal role in contracts, and their clear delineation can facilitate (1) the drafting of PPP contracts rich in pertinent information, (2) enable a more informed and effective assessment of risks, and (3) facilitate knowledge management, which contributes to better risk and contract management in subsequent PPP projects. Therefore, developing a comprehensive list of PPP information requirements holds substantial potential for significant contributions to academic literature and current PPP practice.

This paper is part of a multi-step research study. The ultimate output of the research study is a qualitative risk assessment tool for the public party and its consultants to streamline structured data collection, avoid overlooking important project and financial information in risk assessment, and facilitate knowledge management in PPPs. The scope of this paper is the identification of the information requirements that are utilised as pivotal inputs in the qualitative risk assessment tool. The detailed information gathered under these requirements can be applied to contract drafting and conducting thorough risk assessments. Moreover, the information collected under these requirements has the potential to facilitate information management within PPP projects and knowledge transfer among projects, rendering the developed tool suitable for KM in PPPs.

The methodology employed three steps, combining a literature review, expert interviews, and the Delphi Technique. The information requirements identified from the literature were categorised and updated with the expert interviews and then validated through the Delphi Technique, which involved three rounds of consultations with 12 legal experts with experience in PPPs. This process ensured the validity of the identified information requirements, which were integrated into a PPP risk assessment tool presented in Kuru & Artan (2024), enabling the collection and utilisation of structured data and facilitating knowledge management for effective risk and contract management in PPPs.

2.0 LITERATURE REVIEW

2.1. Previous Studies on Information Requirements and Knowledge Management in PPPs

The importance of risk management in sustaining the contract and ensuring good performance in PPPs is emphasised by IBRD and the World Bank (2017). In this regard, it is also indicated that the information requirements of the project should be defined within the contract, and these requirements should be monitored and enforced by the government entities. These critical statements of the IBDR and the World Bank (2017) prove the importance of identifying the PPP information requirements and managing knowledge in PPPs. There are various definitions in the previous studies about knowledge management (KM). Scarbrough et al. (1999) define KM as processes or practices to increase the performance of organisations by creating, getting, sharing, and utilising knowledge. O'Dell and Jackson (1998) point out that, as a part of KM strategy, getting the essential knowledge to the right people, and utilising that information helps improve the organisation's performance. Cross (1998) asserts that KM is valuable for new business value. Gallupe (2001) emphasises the importance of knowledge for organizations by underlining its competitive advantage and defines the sub-steps related to it as creating/acquiring knowledge, retaining and storing knowledge, disseminating and using knowledge, and protecting and managing knowledge. Conducting these steps of KM can create advantages based on the nature of the business. For instance, Ahmad and An (2008) express that using KM in the construction industry can decrease project costs and total duration, and increase quality.

As a construction project delivery model and finance model, PPPs generally have a fragmented nature and include multiple contracts that allocate diversified risks to numerous stakeholders in various phases (World Bank, 2017). Hence, information and KM can become more complex in PPPs than in other construction projects. However, Aerts et al. (2017) defined some of the drivers for KM in PPPs, and the complexity of PPPs was identified as a driver factor. Based on this approach, proposing models for information and KM against the complexity of the PPPs can be assessed as a required action for the PPP sector. While there are proposed models in the literature for information and KM, their numbers are not high, and there is a lack of studies that attempt to determine the information requirements of PPPs. For instance, Huang et al. (2022) developed an information integration framework for the risk and reward mechanisms of a PPP urban rail transit project. However, the study did not list information requirements that should be integrated into the framework. Another example is an information management method that Jiang et al. (2023) proposed to contribute to PPP risk management and reuse knowledge. In their research, as a limitation, it was stated that the research did not cover all the information on PPP project risks and could be extended more.

In light of these explanations, the literature on PPP information requirements studies was reviewed using the Web of Science and Scopus databases to determine the PPP information requirements. The research criteria were determined as "public-private partnership" in the "abstract" and "information requirement" in "any field." In Web of Science, no publication was suitable for this filtering. In Scopus, only 12 studies were available, but upon closer inspection, all were found irrelevant. Due to the lack of academic studies on PPP information requirements, an attempt was made to search for sectoral papers and reports, yet the same situation was seen there. Only one exception was observed. ADB (2016) lists some information requirements for the project identification and PPP screening stage, but they are not detailed. Currently, it is not possible to determine PPP information requirements from the literature using "information requirement" as a keyword. The lack of studies points out a remarkable gap related to the PPP information requirements in the literature. This gap can also poses an obstacle to the creation of models and systems for knowledge and information management in PPPs. For this reason, this research aims to identify and validate the information items the public party requires for effective contract and risk management in PPP projects undertaken in the construction sector.

2.2. Determination of the Information Requirements for PPPs

PMI (2016) suggests using various documents such as manuals, procedures, research, and regulations, to determine information requirements. As a way to fill the literature gap in the PPP information requirements, reviewing some sources (e.g., documents and sectoral reports) and making subjective judgments was preferred as the initial step of this study's approach. Some journals and books were also reviewed, yet the "information requirement" keyword was not seen in the documents. Instead, the researchers determined what might be an information requirement. All sources were methodically reviewed during the information requirement selection process. Special attention was given to headings, drawings, tables, and bullet points. Subsequently, some of the terms and statements within these sources were identified as draft requirements.

PPP contracts comprise diverse project-specific details, and, in this context, the inclusion of specific PPP contracts within the determination process of requirements was also deemed suitable in this study. Access to the detailed provisions of most PPP contracts is not possible owing to confidentiality considerations; however, there are some exceptions. For instance, the PPP contract for Kosovo Pristina International Airport (2010) was publicly accessible and was subjected to scrutiny by the researchers in the context of the requirement determination process. Infrastructure BC, an entity owned by the Province of British Columbia, also publishes comprehensive project documents and contracts on its website, allowing unrestricted access to the public. A hospital PPP project contract was identified by the researchers on this website and was integrated into the requirement determination process (Fort St. John Hospital Project, 2009). As previously elucidated, PPP represents both a project finance methodology and a construction project delivery approach. Therefore, supplementary resources like project management publications such as PMBOK (2021) and Prince2 Agile (Richards, 2018) were also included in the analysis in addition to PPP-specific literature.

Both qualitative and quantitative information requirements were compiled during the document review process. Following the requirement determination process, qualitative requirements were named "PPP Project Information Requirements" in Table 1, while quantitative requirements were named as "PPP Financial Information Requirements" in Table 2. These tables were named draft lists until validation with Delphi.

Table 1. Draft PPP Project information requirements based on literature review.

General Project Information	**Source No. and Page**
Project Description and Scope	11(p.440)-13(p.84)
PPP Type	4(p.256)
Public Party	8(p.38)-12(p.6)
Sponsor	8(p.38)-12(p.6)
Lenders	3(p.6)-8(p.38)
Consultant	8(p.38)
Suppliers	12(p.6)
Contractors	12(p.6)
Operator	12(p.6)
Users	8(p.38)
Other Stakeholders (Unions, Media, etc.)	8(p.38)-12(p.6)
Contract General Information	**Source No. and Page**
Bid Submission Date/Tender Date	1(p.272)-3(p.5)-6(p.22)
Contract Type	1(p.272)-6(p.20)
Construction Period	4(p.256)-6(p.222)-10(p.143)
Concession Period	4(p.256)-6(p.222)-10(p.143)
Repayment Period	1(p.236)-7(p.253)
Expiry Date	2(p.2)-3(p.10)
Finance, Insurance and Warranties	**Source No. and Page**
Currency	3(p.9)-6(p.253)
Equity/Debt Ratio	5(p.31)

Loan Financing	1(p.272)
Recourse-Non-Recourse	1(p.228)
Insurance	2(p.19)-3(p.80)-4(256)-10(p.143)
Escrow	1(p.136)-6(213)
Contingency	6(214)
Guarantees, Warranties, Performance bonds	6(214)
Legal and Technical	**Source No. and Page**
Laws	2(p.10)-3(p.10)
Regulations	3(p.10)
Permits, Consents, License	2(p.10)-3(p.19)
Quality standards	3(Annex 12)
Specifications	2(p.10)-3(Annex 13)
Intellectual Property Rights	2(p.38)-3(p.95)
Project General Analysis	**Source No. and Page**
Value Proposition	13(p.252)
Milestones	13(p.241)
Success Criteria	13(p.96)
Boundaries/Constraints	11(p.440)-13(p.174)
Assumptions	11(p.440)-13(p.174)
Strengths	11(p.394)-13(p.177)
Weaknesses	11(p.394)-13(p.177)
Opportunities	11(p.394)-13(p.177)
Threats	11(p.394)-13(p.177)
Mechanisms and Provisions	**Source No and (Page)**
Rate/Tariff Adjustment Mechanism	5(p.31)-10(p.143)
Exclusivity Provisions	3(p.23)
Compensation Cases	2(p.50)-6(p.198)-9(p.64)
Relief Events	2(p.29)-6(p.198)-9(p.17)
Force Majeure	2(p.31)-3(p.83)-6(p.224)-9(p.15)
Extension of Time Conditions	2(p.3)-3(p.40)-9(p.23)
Dispute Resolution Mechanisms	2(p.53)-3(p.99)-9(p.107)
Early Termination Provisions	2(p.50)-3(p.85-87)-9(p.24)
Early Termination Payments	2(p.50)-3(p.89)-6(230)-9(p.61)
Defects Liability Period Provisions	3(p.7)-6(p.198)
Sources; [1]Akintoye et al. (2003), [2]Fort St. John Hosp. Agreement (2009), [3]Kosovo Pristina International Airport PPP Contract (2010), [4]Yuan et al. (2012), [5]Ogunsanmi (2013), [6]Boussabaine (2014), [7]Chen et al. (2015), [8]ADB (2016), [9]IBRD and World Bank (2017), [10]Mohamad et al. (2018), [11]Richards (2018), [12]Wojewnik-Filipkowska & Wegrzyn (2019), [13]PMI (2021).	

Table 2. Draft PPP financial information requirements based on literature review.

Financial Information Requirements	1	2	3	4	5	6
Demand Projection	■	■	■		■	■
Tariff/Toll Level	■	■	■	■	■	■
Initial Working Capital	■	■		■	■	
Amount (Loan)	■	■	■		■	■
Maturity	■	■	■	■		
Debt/Equity		■	■	■		
Inflation	■	■	■	■		■
Interest Rate	■	■	■	■	■	■
Exchange Rate	■	■	■	■	■	■
Project Costs	■	■	■	■	■	
Financing Cost	■	■	■	■	■	■
Construction Cost	■	■	■	■	■	■
Operational Cost	■	■	■	■	■	■
Maintenance Cost	■	■	■	■	■	■
Tax	■	■	■	■	■	■
Depreciation		■	■			■
CAPEX	■	■	■	■		■
OPEX	■	■		■		
Contingent Liabilities	■		■			■
Contingency Funding	■	■	■	■		
Revenue	■	■	■	■	■	■
CFADS (Cash flow for debt service)		■	■	■	■	■
Net Cash Flow	■	■	■	■	■	■
EBITDA		■	■		■	■
NPV (Net Present Value)	■	■	■	■	■	■
IRR (Internal Rate of Return)	■	■	■	■	■	■
ROI (Return on Investment)	■	■	■	■		
ROE (Return on Equity)	■	■	■	■	■	
WACC (Weighted Average of Cost of Capital)	■	■	■	■		
Interest Covering Ratio		■			■	
DSCR (Debt Service Cover Ratio)	■		■	■	■	
ADSCR (Annual Debt Service Cover Ratio)	■	■	■	■		
LLCR (Loan Life Cover Ratio)	■	■	■	■	■	
PLCR (Project Life Coverage Ratio)	■	■	■	■		

References; [1]Grimsey & Lewis (2004), [2]Yescombe (2007), [3]PPIAF (2009), [4]Boussabaine (2014), [5]Kurniawan et al. (2015), [6]IMF and World Bank (2022).

3.0 METHODOLOGY

This paper is part of a research study conducted to develop a knowledge-based risk management tool for PPP projects. The methodology of the research study is summarized in Table 3. Steps 2, 3, and 4 were conducted within the scope of this paper.

Step 1 is a previous step completed before this paper. In this step, PPP risk factors that must be assessed by the public party during the risk management process of PPPs were determined and validated. Steps 2, 3, and 4 are the steps included in this paper's scope. In Step 2, information requirements that can be used in PPP projects were determined through a literature review. The determined information requirements were named as draft PPP information requirements. As mentioned in the literature review, no studies directly point out the information requirements of PPPs, and this caused a gap in the literature. Hence, the information requirements review tables were formed with subjective judgments based on reviewing some documents and sources. This approach necessitates the validation of these requirements. The Delphi Technique was chosen to validate the requirements because it is an expert judgment technique. Besides that, before the validation via Delphi, expert interviews were conducted in Step 3. These interviews were not a direct part of the Delphi study. This step was carried out to check whether the PPP experts correctly understood the items. Moreover, taking additional requirement recommendations from the experts and categorizing the requirements became possible with this step.

Table 3. Methodology.

		Steps	Method	Input	Output
Identification of PPP risks (Previous work)	Step 1	Identification and validation of risk factors	Literature review and Delphi technique	Articles, books, sectoral documents, expert views	Validated PPP risk factors
Identification of PPP information requirements (This paper)	Step 2	Identification of PPP information requirements from academic studies	Literature review	Articles, books, sectoral documents	PPP information requirements (draft)
	Step 3	Identification of additional PPP information requirements used in practice and categorization	Expert interviews	PPP information requirements (draft)	Revised and categorized PPP information requirements (draft)
	Step 4	Validation of PPP information requirements	Delphi technique	Revised and categorized PPP information requirements (draft)	Validated PPP information requirements
Prototype development for a qualitative risk assessment tool (Kuru & Artan, 2024)	Step 5	Prototype development	Microsoft WinForms App, DevExpress components	Validated PPP risk factors Validated PPP information requirements	Prototype
	Step 6	Validation and verification of the prototype	Usability survey, interviews	Prototype, survey results, collected feedback	Validated prototype

There were two main criteria during the selection of the experts. The experts' knowledge had to encompass both the financial aspects and general structure of PPPs, which makes the expert capable of assessing both the PPP project information requirements in Table 1 and the PPP financial information requirements in Table 2. The second criterion was about the PPP experience. Ten years of average PPP experience was defined as a criterion since it was assumed that this duration could be very suitable for having the essential level of knowledge about the general and financial side of PPPs. There were four experts in this step. All the participants were from Turkey, where this model has often been applied for the last 20 years, and all of the experts have more than ten years of PPP experience. Three participants were managers in the project consultant firms who gave consultancy to both the public party and private parties in PPP management related issues, especially in risk and contract management. The fourth expert was from the public party. The interview with this expert was specially conducted as the last interview since this expert was working in the PPP department of a public institution. Thus, this expert made the final check on the items before Delphi. The experts were requested to review and categorize the items in the tables and provide recommendations for any additional information items that were not included in the previous step.

In Step 4, a Delphi study was conducted to validate the updated and categorised information requirements. Thus, the output of this paper became the validated list of PPP project information requirements, as presented in Table 6, and the validated list of PPP financial information requirements, as presented in Table 9. The outputs of Step 1 (validated risk factors list) and Step 4 (validated list of PPP information requirements) were integrated into a risk management model in Kuru & Artan (2024). For this purpose, in Step 5, the risk management prototype was developed as a Microsoft Windows Forms desktop app with DevExpress components. In step 6, this model's validation and verification process was conducted. The validation usability survey was applied to 21 experts, and the verification expert interviews were conducted with 13 experts. Further details on the development and testing of the system are presented in Kuru & Artan (2024).

3.1. Delphi

The Delphi technique engages in querying experts regarding a particular subject using either a questionnaire or an interview (Dalkey & Helmer, 1963). Despite participants not engaging directly, the Delphi method operates as a group decision technique. The technique is adaptable to various disciplines, including construction management. For instance, Che Ibrahim et al. (2020) emphasise the established use of Delphi in construction management for purposes such as selecting criteria, construction safety, team integration, and risk management. In the modified Delphi model, literature review can be conducted before the Delphi, and items can be pre-established (Woodcock et al., 2020). Since information requirements were formed as a list before the Delphi by reviewing the documents, this study started with a ready list of items. In other words, the modified Delphi approach was used in this study.

3.1.1. Determining Sample Size

There is no standard for determining the sample size of a Delphi study and no consensus regarding the sample size (Akins et al., 2005). Staykova (2019) emphasises that Delphi does not require a very large sample size and provides an opportunity to obtain reliable findings with a small sample size. Cavalli-Sforza and Ortolano (1984) explained that a typical Delphi study involves 8–12 respondents. Rowe and Wright (2001) recommended working with 5–20 experts in a Delphi survey. Adler and Ziglio (1996) affirmed that significant results could be achieved even with a participant number as low as 10-15. In line with these assertions, it is possible to find numerous Delphi studies in the literature with few participants. For instance, 7 participants were included in the study of Dalkey and Helmer (1963). Based on these explanations, conducting this study with at least "10 experts" was planned by the researchers.

3.1.2. Participant Profile

Luzon and El-Sayegh (2016) stress that participants in a Delphi study are not chosen randomly. Instead, participants are specifically targeted for their expertise in a particular field. As mentioned in the introduction, the validated information requirements in this study were determined to be integrated into a qualitative risk assessment tool. The potential users of this software were determined as "Public Party," "PPP units of the

country," "PPP legal consultants," and "other PPP consultants." Because they analyse the project risks in contract-related processes, the primary target group was ascertained as legal consultants. Careful attention was given to choosing participants from among legal consultants involved in international PPP projects. Participants were identified from the Legal 500 website, which lists the world's leading law firms and lawyers, and they were contacted accordingly. The common characteristic of the selected legal consultants is having experience and knowledge in project contract management and risk management processes. The average PPP experience of the group was more than 11 years, and the number of PPP project experiences was more than 14, as presented in Table 4. In addition, a minimum of three years of experience criteria for each expert was applied since having experience of less than three years may not be sufficient for the study. The PPP projects in which the participants have been involved are generally located in developing countries. Since this study aims to identify the information needs that may arise in all PPP projects conducted in the construction industry, neither specific PPP type experience (such as Build Operate Transfer, Build Lease Transfer, etc.) nor expertise in a particular type of construction (such as roads, hospitals, energy, among others) was defined as a criterion during participant selection. The participant profile is presented in Table 4. The Delphi study was conducted through email. The subsequent section will provide a more detailed explanation of the process. Response rates are given in Figure 1.

Table 4. Participant profile of the Delphi study.

Experts	PPP Experience	Number of PPP Projects
Expert 1	20+	20+
Expert 2	9	7
Expert 3	3	4
Expert 4	17	40
Expert 5	13	Not Stated
Expert 6	15	20+
Expert 7	10+	10+
Expert 9	Not Stated	Not Stated
Expert 10	10+	5
Expert 11	12	5+
Expert 12	15	30
	Mean>11	Mean>14

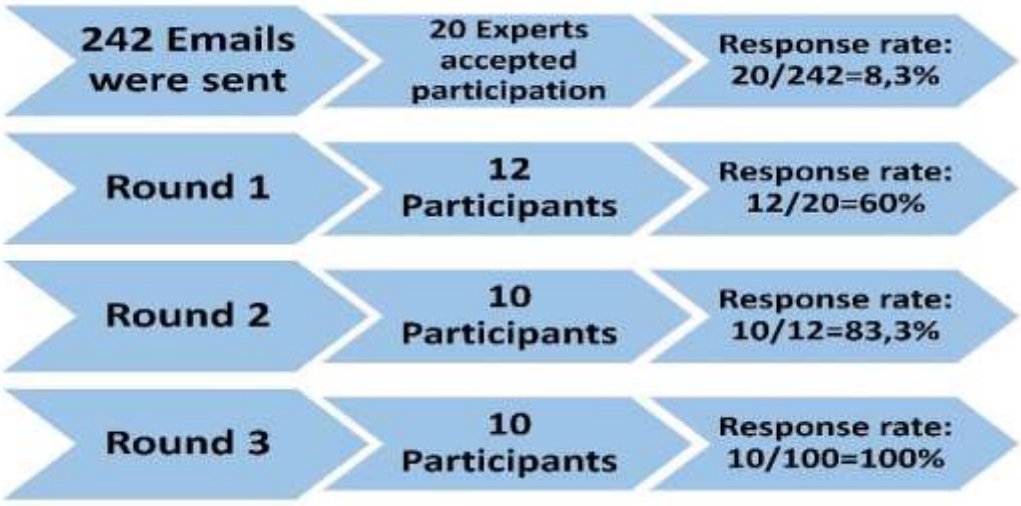

Figure 1. Participant numbers and response rates based on round.

3.1.3.Delphi Process

The Delphi survey was conducted by e-mail. Numerous studies in the construction and PPP literature were conducted Delphi through e-mail (Manoliadis et al., 2006; Anvuur et. al, 2007; Yeung et al., 2009; Kukah et al., 2024). For instance, Gyamfi et al. (2022) utilised the Delphi method to comprehend the problems related to PPPs in Ghana's construction industry, and they expressed that the Delphi questionnaire can be distributed through e-mail. Carbonara (2015) also underlines that conducting Delphi through e-mail is possible, and this approach enables the participation of people from various geographical areas, which is essential for international research.

The first e-mail described the study's purpose and expectations from the participants. An Excel document containing four pages was attached to the e-mail. The content of the pages is summarised in Figure 2.

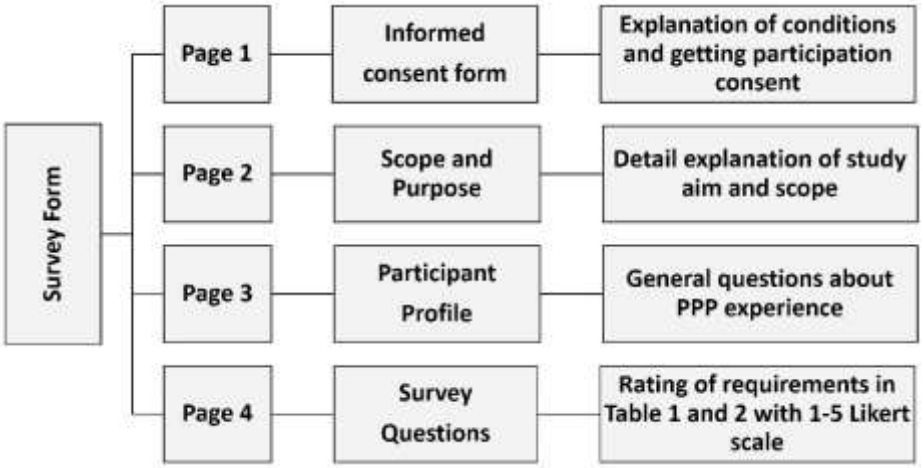

Figure 2. Content of the Delphi survey form.

The first sheet was the "informed consent form," which explained the general conditions and sought the participant's approval. In the second sheet, researchers delineated the details of the risk management software intended to be developed, explaining its relevance to the survey. The target audience and potential usage areas of the software were also summarised for the participants, as illustrated in Figure 3.

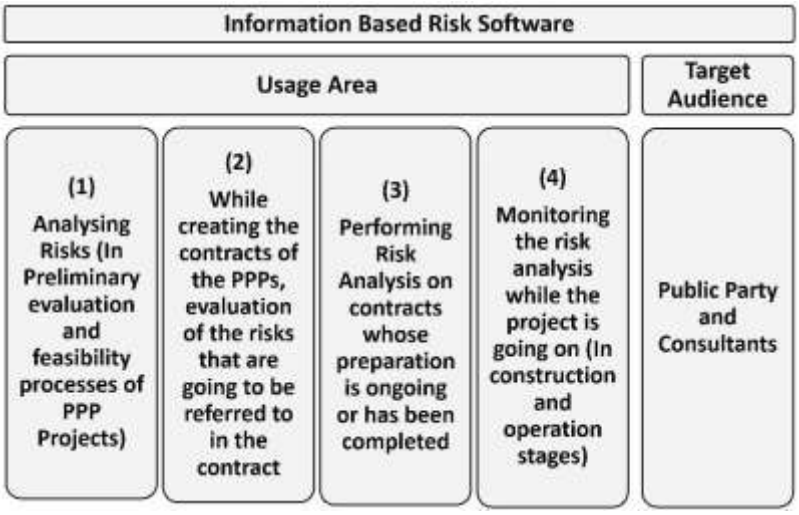

Figure 3. Potential usage areas and potential target audience of the planned software.

In the last sheet, a single question was directed to the experts: "Do you agree that these items are 'Project Information Requirements' in PPP projects for the Public Party?" "Project Information Requirements" were described in the survey form as follows: Information that can be recorded/collected regarding project details/project risks can be used in the analysis and follow-up of project details/project risks. The assessment scale was a 1-5 Likert scale that ranges from "Strongly disagree" to "Strongly agree."

3.1.4. Delphi Statistics and Consensus Criteria

Some researchers use frequency values to define consensus level in Delphi research. Barrett and Heale (2020) state that the previously determined consensus values in the literature varied between 51% and 100%. As another alternative, some studies consider dispersion statistics such as standard deviation and interquartile range (Giannarou & Zervas, 2014). For instance, Tengan and Aigbavboa (2021) used IQR as a consensus criterion in their studies and selected IQR ≤ 1. As a third option, instead of looking at a single value, some researchers prefer to use both the frequency-based and statistics-based consensus (Fan & Cheng, 2006). This approach was used in this study, and both the frequency and IQR values were calculated and assessed.

The criteria are set as follows: If "IQR ≤ 1" and "% of Agree ratings (Rating 4 and 5) ≥ 50%" and "Median ≥ 4" and "Mode ≥ 4", the Information Requirement was added to the final list. If "IQR ≤ 1" and "% of Agree ratings (Rating 4 and 5) < 50% or Median < 4 or Mode < 4", the Information Requirement was excluded from the list. The other scenarios were appraised as "not agreed/no consensus," and those Information Requirements were carried over to the following round.

4.0 RESULTS

In the third step of the methodology (Table 3), expert interviews were conducted to determine PPP information items from the current PPP practice in addition to items determined from the literature. New requirements resulting from the expert recommendations in Step 3 are as follows, along with the group names they were included in: Contract General Information (Implementation contract signing date, Contract effective date, Operation period); Finance, Insurance and Warranties (Private party shareholders percentages, Repayment program/plan); Legal and Technic (Guidelines); Mechanisms and Provisions (Revenue sharing mechanism, Hand back requirements); Financial Information Requirements (Maximum allowable tariffs). These items were also added to the tables, and the Delphi study was conducted in Step 4 with the revised PPP information tables.

As a result of the Delphi process, the number of Agreed and Excluded “PPP Project Information Requirements” is obtained and given in Table 5 according to the Delphi rounds. Five items not agreed upon at the end of the three rounds were re-assessed by updating to IQR ≤ 1.25 since similar values are also used in the literature (Hussein, 2010).

Table 5. Summary of Delphi rounds for PPP project information requirements.

	Included	**Excluded**	**Transferred to Next Round**
Round 1	33	0	24
Round 2	9	4	11
Round 3	6	0	5
For IQR ≤ 1.25	4	1	
Total	52	5	

An overview of all the analysis rounds demonstrates that 52 out of 57 project information requirements were included in the final list. The included requirements are presented in Table 6, while the excluded requirements are presented in Table 7.

Table 6. Validated PPP project information requirements final list.

Project Information Requirements (Included)		
Very Strong Consensus (90%-100%) – 38 Requirements	Ratings (4-5)	Median-Mode-IQR
Project Type (Road, Hospital, Airport, etc.)	100%	5-5-0
Project Description and Scope	100%	5-5-0
Construction Period	100%	5-5-1
Operation Period	100%	5-5-0,75
Concession Period	100%	5-5-0,75
Expiry Date	100%	5-5-0,75
Currency in the Contract	100%	5-5-0,75
Laws Related to the Project	100%	5-5-0
Regulations Related to the Project	100%	5-5-0
Permits, Consents, Licenses	100%	5-5-1
Compensation Cases / Penalties	100%	5-5-1
Relief Events	100%	5-5-1
Extension of Time Conditions/Provisions	100%	5-5-1
Dispute Resolution Mechanism	100%	5-5-1
Early Termination Conditions/Provisions	100%	5-5-0,75
Early Termination Payments	100%	5-5-0
Operator (Name and General Information)	100%	5-5-0,25
Intellectual Property Rights	100%	4-4-1
Public Party (Name and General Information)	92%	5-5-1
Sponsor (Name and General Information)	92%	5-5-1
Contract Effective Date	92%	5-5-1
Contract Type (BOT, BLT, etc.)	92%	5-5-0
Repayment Period	92%	5-5-1
Guarantees/Warranties	92%	5-5-1
Specifications of the Project	92%	5-5-0
Rate setting/Tariff Toll Adjustment Mechanism	92%	5-5-0,75
Revenue Sharing Mechanism	92%	5-5-1
Hand back Requirements	92%	5-5-0,75
Defects Liability Period Conditions/Provisions	92%	5-5-1
Force Majeure	92%	4,5-5-1
Exclusivity Provisions	92%	4-4-0,75
Loan Financing Structure	90%	4,5-5-1
Insurance Details	90%	4,5-5-1
Milestones of the Project	90%	4,5-5-1
Contingency Details	90%	4-4-0
The Value Proposition of the Project	90%	4-4-1
Boundaries/Constraints of the Project	90%	4-4-0,25
Assumptions Related to the Project	90%	4-4-1
Strong Consensus (80%-89,99%) – 9 Requirements	Ratings (4-5)	Median-Mode-IQR
Contractors (Name and General Information)	83%	5-5-1
Quality Standards	83%	4-5-1
Guidelines of the Project	83%	4-5-1
Lenders (Name and General Information)	83%	4-5-1
Implementation Contract Signing Date	80%	5-5-0,5
Tender Date	80%	5-5-0,5
Users (General Information About Potential Users)	80%	4,5-5-1,25
Threats Related to the Project	80%	4-4-0,5

Success Criteria	80%	4-4-1,25
Moderate Consensus (70%-79,99%) – 3 Requirements	Ratings (4-5)	Median-Mode-IQR
Escrow Account Details	70%	4-4-1
Strengths of the Project	70%	4-4-1,25
Weaknesses of the project	70%	4-4-1
Weak Consensus (60%-69,99%) – 2 Requirements	Ratings (4-5)	Median-Mode-IQR
Private Party Shareholders Percentages	60%	4-4-1
Repayment Program/Plan	60%	4-4-2

Table 7. Excluded PPP project information requirements.

Project Information Requirements (Excluded)	**Rating (1-2)**	**Rating (3)**	**Rating (4-5)**	**Median-Mode-IQR**
Other Stakeholders (Unions, etc.) Information	0%	50%	50%	3,5-4-1
Consultants (Name and General Information)	0%	50%	50%	3,5-3-1
Suppliers (Name and General Information)	0%	50%	50%	3,5-3-1
Recourse-Non Recourse Details	0%	50%	50%	3,5-3-2
Opportunities Related to the Project	10%	60%	30%	3-3-1

Table 8 shows the number of included and excluded "Financial Information Requirements" according to the Delphi rounds. 33 out of 35 requirements were assessed as essential, presented in Table 9. The financial information requirements that were excluded are given in Table 10.

Table 8. Summary of Delphi rounds for PPP Financial Information Requirements.

	Included	**Excluded**	**Transferred to Next Round**
Round 1	11	0	24
Round 2	16	2	6
Round 3	3	0	3
For IQR ≤ 1.25	3	0	
Total	33		

Table 9. Validated PPP Financial information requirements final list.

Financial Information Requirements (Included)		
Very Strong Consensus (90%-100%) – 15 Requirements	Ratings (4-5)	Median-Mode-IQR
Construction Cost	100%	5-5-1
Tax	100%	4,5-4-1
CAPEX	100%	4-4-0,25
OPEX	100%	4-4-0,25
Tariff/Toll level	92%	5-5-1
Maximum Allowable Fees and Tariffs	92%	5-5-0
Project Costs	92%	5-5-1
Operational Cost	92%	5-5-1
Maintenance Cost	92%	5-5-1
Financing Cost	92%	4,5-5-1
Contingent Liabilities	90%	4-4-0,25
Net cash Flow	90%	4-4-1
Interest Coverage Ratio	90%	4-4-0
DSCR (Debt Service Coverage Ratio)	90%	4-4-0
LLCR (Loan Life Coverage Ratio)	90%	4-4-0
Strong Consensus (80%-89,99%) – 11 Requirements	Ratings (4-5)	Median-Mode-IQR

Demand Projection	83%	5-5-1
Revenue	83%	4,5-5-1
CFADS (Cash Available for Debt Service)	83%	4-5-1
Loan Amount	80%	4,5-5-1,25
Inflation	80%	4,5-5-1,25
Initial Working Capital	80%	4-4-0,25
Maturity	80%	4-4-0,25
Debt/Equity	80%	4-4-0,25
Contingency Funding	80%	4-4-0,25
ADSCR (Annual Debt Service Coverage Ratio)	80%	4-4-0,25
Exchange Rate	80%	4-4-0,5
Moderate Consensus (70%-79,99%) – 2 Requirements	Ratings (4-5)	Median-Mode-IQR
Depreciation	75%	4-4-0
IRR (Internal Rate of Return)	70%	4-4-1
Weak Consensus (60%-69,99%) – 5 Requirements	Ratings (4-5)	Median-Mode-IQR
EBITDA	60%	4-4-1
PLCR (Project Life Coverage Ratio)	60%	4-4-1
Interest Rate	60%	4-4-1,25
ROE (Return on Equity)	60%	4-4-1
NPV (Net Present Value)	60%	4-4-1

Table 10. Excluded PPP financial information requirements.

Financial Information Requirements (Excluded)	**Rating (1-2)**	**Rating (3)**	**Rating (4-5)**	**Median-Mode-IQR**
ROI (Return on Investment)	10%	40%	50%	3,5-3-1
WACC (Weighted Average Cost of Capital)	10%	60%	30%	3-3-1

5.0 DISCUSSION

5.1. Discussion About PPP Project Information Requirements

The experts agreed on 52 of the 57 draft requirements as "project information requirement," which shows that the content of the subjectively composed draft list is well selected. Seventeen items were rated with 100% agreement, and all had "5" as the median and mode values. If those items are reviewed, it is seen that nearly half of them are related to the general information of the project, such as project type, scope, and construction-operation-concession periods. This proves that the experts see this kind of general information as essential for project analysis. This may be due to including all this information in project contracts (Kosovo Pristina International Airport, 2010). Defining the project's scope and specifying key dates, such as construction end and operation start dates, is fundamental for comprehensive risk management because efficient risk management necessitates clear boundaries established within the contract. The utilisation of the "Project charter" as an input in the initial phase (planning) of risk management, as per the approach of PMI (2017), corroborates the importance of these requirements, particularly during the risk management planning phase.

Other items that have 100% agreement are more rule/procedure-based. For instance, laws, regulations, permits, and consents. In addition, the experts evaluated mechanisms that can be applied to some problems as highly essential requirements. Some examples include dispute resolution mechanisms, compensation cases, and early termination cases. The rationale behind this selection can again be associated with the content of the PPP contract. For instance, significant stakeholder disputes can lead to considerable risks like cost overruns and delays (Global Infrastructure HUB & Allen Overy, 2019). Hence, dispute resolution mechanisms gain importance in projects. In this manner, including proposed information items (e.g., dispute resolution mechanisms, compensation cases, and extension of time conditions) in the contracts can streamline risk management.

Despite assessing the "Name and general information" of the Public Party, Sponsor, Contractor, Operator, and Lender as required items, experts assessed the "Name and general information" of Consultants, Suppliers, and Other Stakeholders as non-essential. This preference might be associated with not positioning these stakeholders in the foreground of the typical PPP project structure (ADB, 2016). Additionally, details regarding the projects "Opportunities" and "Recourse" were also not considered essential. Although these excluded requirements did not meet the determined criteria, it is evident that experts' responses predominantly indicate "Neither agree nor disagree" for these items. In other words, most participants have a level of uncertainty for most of these items. Furthermore, the number of experts advocating for these items to remain on the list outweighs those suggesting exclusion. This result indicates that some experts believe these requirements could be utilized. Hence, those requirements should be used optionally. Nonetheless, as this study aims to comprehend the collective viewpoint of the chosen expert group, they were not included in the final list.

5.2. Discussion About PPP Financial Information Requirements

As previously elucidated, participants evaluated 33 of 35 financial requirements as essential requirements. This result clarifies that the content of the financial information requirement draft list is also well-selected, like the project information requirement list. Besides that, it must be highlighted that the mode and median values of most items in this group are "4". This result shows that participants do not evaluate these Financial Information Requirements as vital as some Project General Information Requirements for the public party. The main reason may be the private party's dominant role in project finance (IBRD, 2017). Since the financial analysis is the role of the private party, experts may have rated it lower.

The top ten ranked financial requirements contain mostly requirements related to the costs of the projects. If the participants had not answered the survey carefully, positioning all cost-related requirements together in the top 10 would not be possible. This result can be interpreted as an indicator of the consistency of the experts. In addition to the cost-related requirements, experts also assessed taxes, tariff/toll levels, and maximum allowable fees as the other items most required by the public parties. These information items are generally included in the financial model of the PPPs, such as PFRAM 2.0 (IMF & World Bank, 2022). Hence, results with high ratings are the anticipated scenario.

The excluded items are "Return on Investment" and "Weighted Average Cost of Capital". Although participants' ratings did not pass the determined thresholds, it is important to underline that disagreement percentages are very low for these items, and their mode/median values are also >=3. However, they were excluded since they were unsuitable for the criteria set. The reason for lower ratings may be the association of these values more with the private party.

5.3. Discussion About Constraints

All the items added to the list before Delphi based on the recommendations of the three consultants and a public party expert were seen as required by the experts in Delphi. That indicates there is a potential for determining many more requirements related to PPPs by interviewing field experts. While existing literature lacks predetermined requirements for PPPs, the study demonstrates the possibility of defining numerous information requirements for these projects. This study's limitation lies in the absence of collecting feedback from experts concerning the items they rated differently than the group. Due to the Delphi study's iterative nature, maintaining the experts' sustained interest presents a challenging task. Demanding compulsory further explanations from the experts might hinder their participation. Thus, written feedback collection was not conducted, although acquiring such feedback could have led to alternative interpretations and enriched the findings.

5.4. Discussion About Usage of Information Requirements

A special PPP risk management software mainly focusing on qualitative risk assessment was developed in the scope of the research study, and details of its development and validation are presented in Kuru & Artan (2024). The PPP information requirements validated in this paper were integrated into the "Project Charter

Menu" and "Project Financials Menu" of the software which enable knowledge management, as presented in Figure 4.

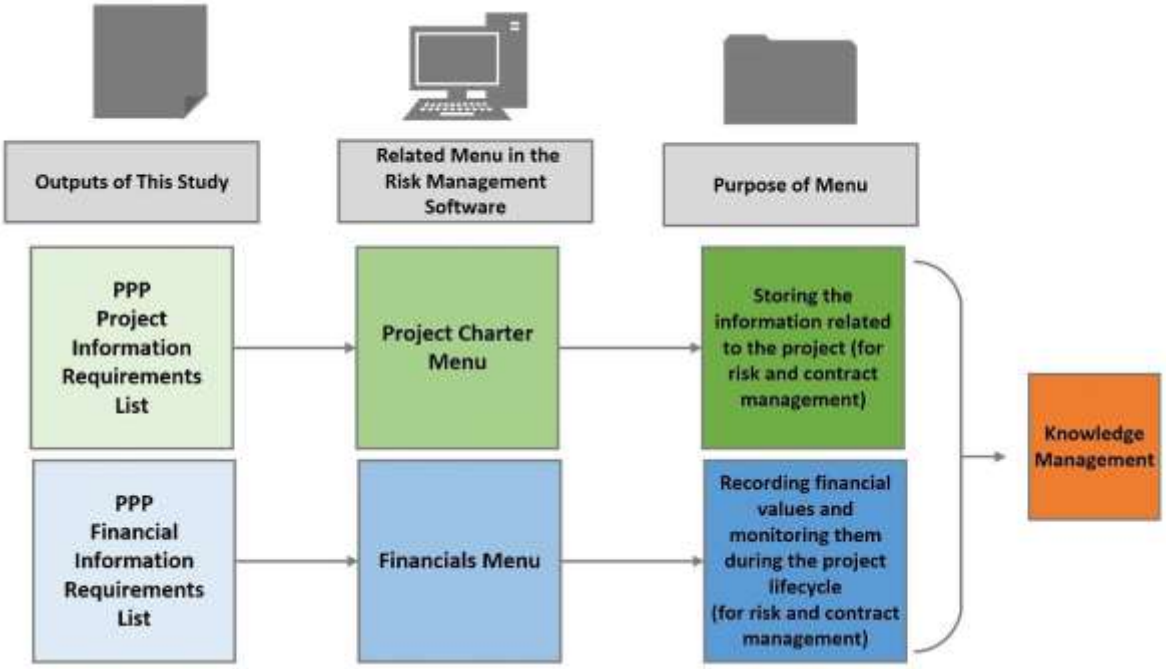

Figure 4. Relations between the outputs of this paper and the developed risk management software

These requirements have information input areas on these menus, enabling users to enter and access detailed information. This integration allows software users to gather comprehensive details related to these requirements. Incorporating comprehensive information under these requirements can enhance the PPP project's risk management and contract management processes. For instance, from the Delphi Study results, “Tariff/toll level” was chosen as one of the financial information requirements. This requirement is related to the project revenues, and it is compulsory to consider tariff/toll levels while evaluating the "low revenue risk" of a PPP project. Another example is the "Extension of Time Conditions." These conditions are stipulated in the contract and applied in the event of a risk occurrence. Hence, they should be included in the contract during the contract formation and can be used during risk management. When a delay risk occurs during the project, the conditions defined previously under these requirements can be considered and applied. Many more examples of using information requirements in contracts and risk management could be given. For instance, under the "law" information requirement, a PPP practitioner can determine the name of all related laws and critical law clauses based on the country where the PPP project is conducted. Thus, practitioners can use the information under this requirement during contract formation. Another information requirement is the "dispute resolution mechanisms". Under this information requirement, the PPP practitioners can clarify the detailed mechanism for resolving disputes in the project, and this information can be transferred to the contract. It is known that there is a strong relationship between contract and PPP risks since the risks are allocated in the contract. If the given instances are considered, the "Law" information requirement is related to the legal risks, and "dispute resolution mechanisms" are related to the dispute risks. These examples demonstrate that the data collected through these information requirements can be utilised in contract and risk management processes.

For the practical usage of the PPP project information requirements, in Figure 5, the Project Charter menu where project information requirements take place is presented. As pointed out in the figure, there are tabs under this menu, and the user clicks the tabs to see the project information requirements based on their groups. In the given figure, “Project General Information” tab is selected. “Project type” and “Project description and scope” requirements are seen on the figure. The requirements on the menu are filled with representative information about the 1915 Canakkale Bridge in Turkey. When the user clicks the fields, an information box

for the related information requirement is opened, and the user can add detailed information to the boxes. Figure 6 shows the information added under the "Project description and scope" information requirement.

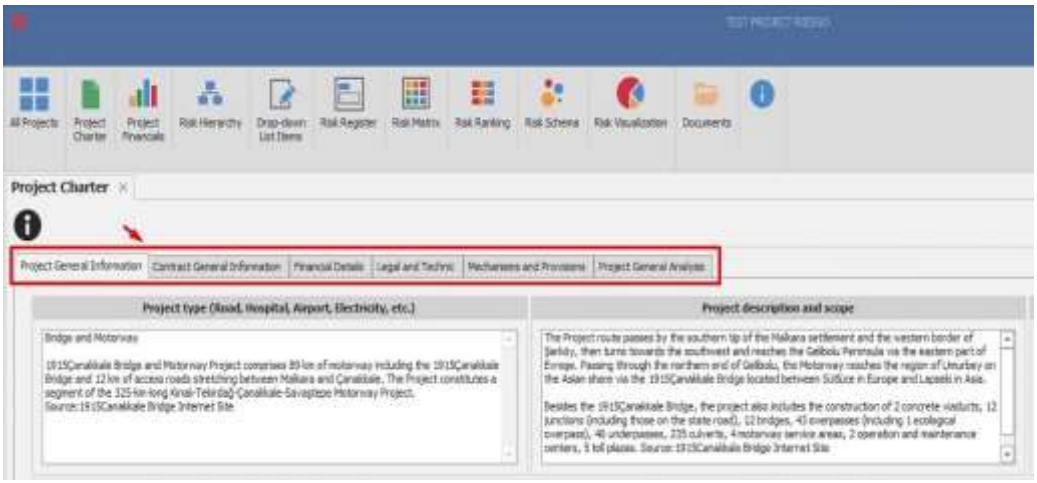

Figure 5. A section of project charter menu of the risk management prototype.

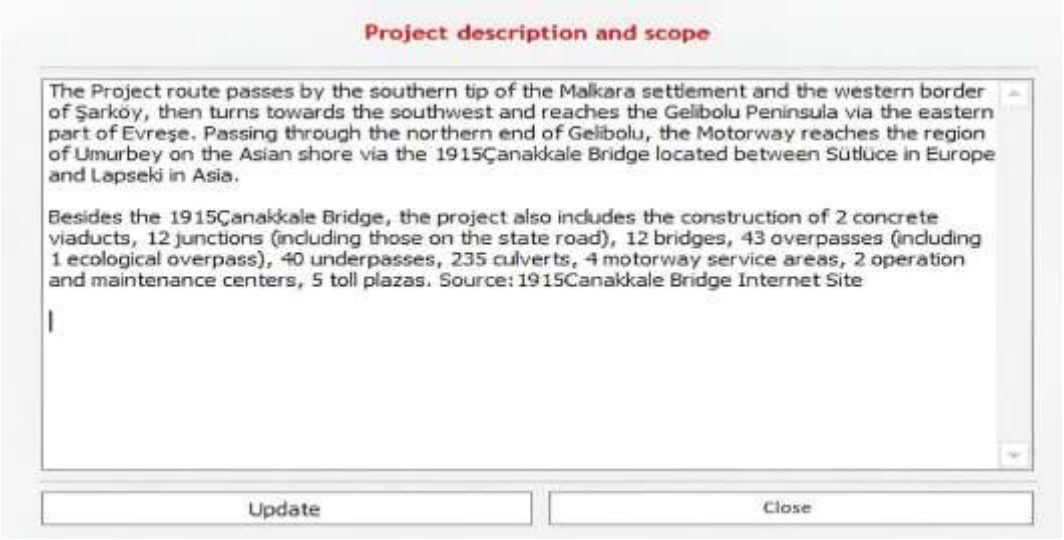

Figure 6. An instance for information requirement box (Project description and scope)

Financial information requirements can be used as threshold values in the contract. An instance is the "Debt service coverage ratio." Lenders who want to minimise risk prefer a higher debt service coverage ratio. A threshold value can also be determined for this ratio. If the ratio does not exceed the determined threshold value, payments to shareholders may be stopped until the value normalises again. If relevant conditions are placed in the contract, default or step-in mechanisms can also be activated if the targeted threshold value is below (ADB, 2016). Another instance is "demand projection". Based on the "demand project" information requirement, a threshold demand value can be added to the contract. If the real value passes the demand projection in the contract, then the parties can make a revenue sharing agreement based on the contract clause details. If the demand is lower than the threshold value in the contract, then the public party can pay the difference in the scope of the demand guarantee (Presidency of the Republic of Turkey Investment Office, 2021).

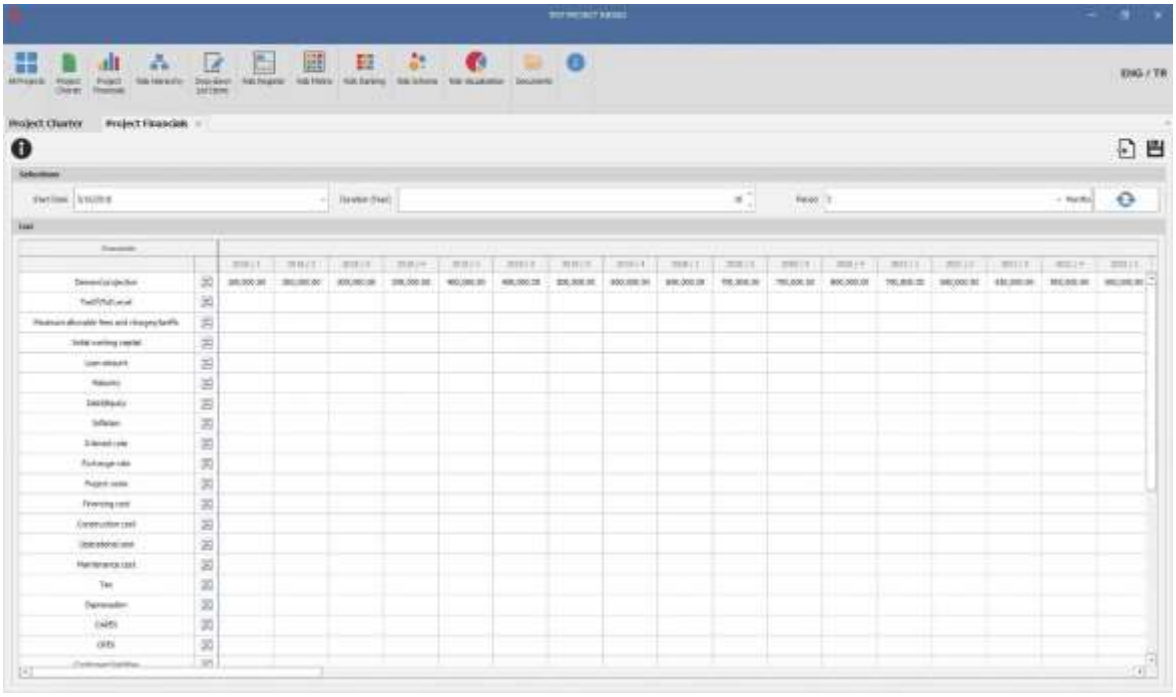

Figure 7. Project financials menu of the risk management prototype.

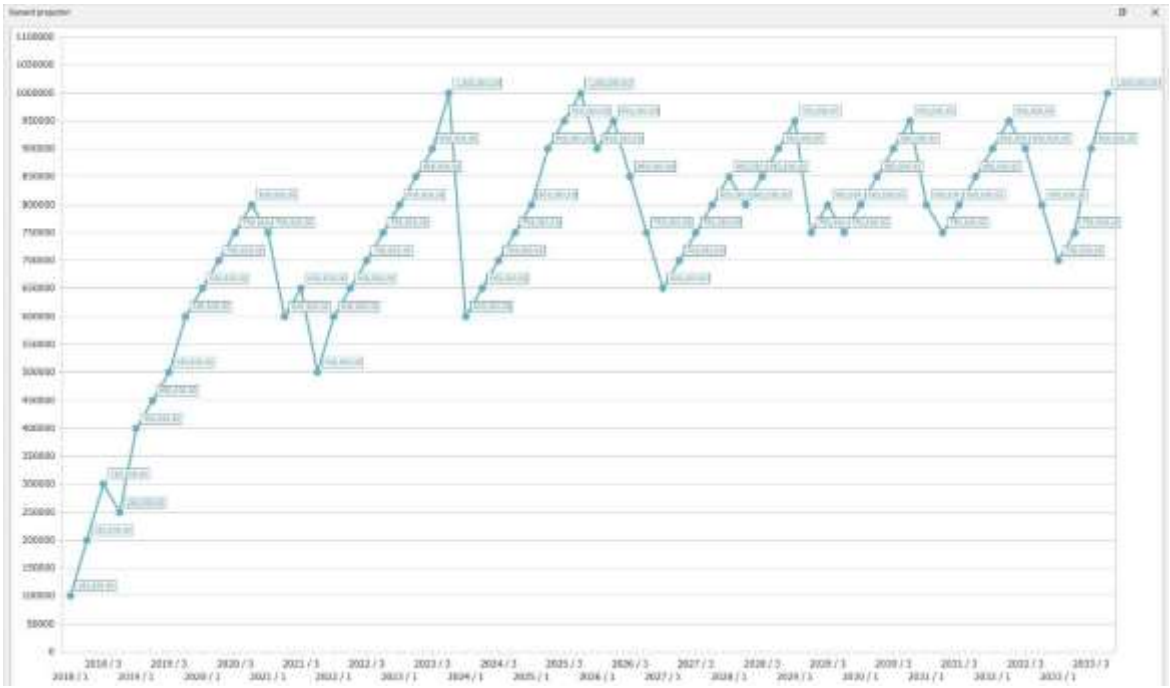

Figure 8. An instance graph to track the financial information requirements (for demand projection).

For the practical usage of PPP financial information requirements, in Figure 7, the Financials menu of the risk management software is presented. On this menu, the financial requirements validated in this paper are listed. Users can enter the values of these financials and track them. In Figure 7, some random demand values are added to the table. As presented in Figure 8, users also have a chance to see all the values on a graph that were entered into the software for a financial information requirement.

To sum up, in the scope of the entire research study, the ultimate outcome is software that can be utilised in the risk, contract, and information management processes of PPP projects. One of the most crucial inputs to

this software, namely information requirements, has been identified in this research. The detailed information collected within these requirements can be used to create project contracts and comprehensively assess and manage project risks. Additionally, all this information can facilitate knowledge management in PPP projects and enable knowledge transfer between projects.

6.0 CONCLUSION

This study was conducted to determine the information requirements that can be utilized for effective risk and contract management of PPP projects. The requirements were determined from the literature and validated with a Delphi study with the participation of 12 legal experts from the sector. The validated final requirements list contains 52 qualitative and 33 quantitative information requirements. The main contribution of this study is (1) the determination of the information requirements for contract management and risk management in PPP projects for the first time in the literature and (2) presenting them to be integrated into knowledge based risk management model for PPPs.

The PPP information requirements identified in this study can serve as a valuable document for academic studies that tackle PPP risk and contract management in the future. Researchers can use the final requirement list and increase the number of these requirements by conducting research with experts in the field. Thus, comprehensive lists can be formed to be used both in the sector and academia. Another alternative is that the requirements in the final table can be detailed with new research. For instance, "early termination conditions" and "early termination provisions" are some information requirements in the final list. A researcher can focus on determining these conditions and provisions by looking at the literature, real contracts, or conducting expert interviews. Detailing these requirements and collecting information about them can increase the knowledge in the field, and the knowledge gained can be transferred to the sector for real PPP contracts.

Furthermore, the information requirements determined in this paper were utilised to develop a qualitative risk assessment tool for the public party and its consultants to streamline structured data collection, avoid overlooking important project and financial information in risk assessment, and facilitate knowledge management in PPPs. The tool was planned and developed as special desktop software for PPPs. The Public Party and its legal consultants can assess the risks in the contract with this software. Since the software contains predefined information requirements as determined in this article, as well as PPP risk factors, compensation, and mitigation mechanisms from previous studies, it is expected to facilitate the risk management process in PPPs. The software also serves some diagrams showing the relation of the risks, probability impact distribution, and pie-chart diagrams showing the risk distribution based on some criteria. Additionally, there are filters to prevent complexity while working on a project that contains hundreds of risks. As a result, the presented model can enable structured data collection, avoid overlooking important contractual aspects, enable comprehensive risk management, facilitate knowledge management, and improve the performance of PPP projects.

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