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Risk Allocation Preferences in Indonesian Electricity Public–Private Partnership Projects: A Conjoint Analysis

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Index Terms— public–private partnership, electricity, infrastructure, Indonesia, conjoint analysis

Abstract—This study investigates the risk allocation preferences of Indonesian government agents within a public–private partnership (PPP) scheme in electricity infrastructure projects. Full-factorial conjoint analysis is employed by introducing three groups of risk factors, namely, "Policy," "Legal," and "Project residual" risks, to form eight distinctive scenarios. A total of 37 respondents from a government agency and other public agencies participated in the experiment, and two distinct clusters within a single party (public entity/government) emerged. The two clusters agree on the order of importance of risk preferences but disagree on nearly everything else. The clusters diverge in the magnitude of risk importance, risk preference scores, profiles, and the most preferred scenarios. This study also determines that the risk preference profiles of both clusters do not consistently follow the optimum risk-sharing principles. Moreover, this study elaborates on the scientific contributions and practical implications of the findings. Results provide essential insights into the risk allocation preferences of the public agents. The findings contribute to the development of mutual understanding between the public and private entities.

I. INTRODUCTION

Indonesia recognizes the importance of electricity infrastructures to address the population's basic needs and maintain economic growth [1]. Unfortunately, the growing demand cannot be met with sufficient supply. The World Economic Forum's report by Schwab [2] indicates that Indonesia ranks 95th and 54th globally regarding electricity access and electricity system reliability, respectively. This gap is expected to widen in the future.

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The Government and other stakeholders long recognized the challenges in accelerating electricity infrastructure projects in Indonesia. Key challenges include accessible capital to finance projects and expertise in technology and project and operations management [3]. Considering these challenges, the Indonesian Government offered multiple schemes to public entities to invest in electricity infrastructure [1]. Such schemes promote the high involvement of private entities in the projects and operations of the infrastructures. Among the initiatives, the Government encourages the public–private partnership (PPP) scheme.

The PPP scheme refers to cooperation built on the expertise of private and public entities to fulfill public needs through appropriate resource, risk, and reward allocation [4]. In a PPP scheme, the Government reaches out to private sectors for a business partnership for an initially public project. To a certain extent, this scheme transfers risks from public to private entities [5] in exchange for fair and reasonable financial benefits.

The PPP process is considered one of the most complex procurement methods owing to the challenging nature of social infrastructure development and multiple clients/users [6]. In the context of a developing nation, the implementation of a PPP entails increased challenges, including limited political commitment, intricated bureaucracy, and uncertainty in contractual procedures [7-9]. In Indonesia, the adoption of PPP is found to be deeply entangled with social and political dynamics [10]. This condition led to difficulties in establishing a comprehensive and consistent regulatory framework. Moreover, it created a unique challenge in capability development in technology and engineering and the management of Government contracting agencies [3]. Interestingly, once the challenges are addressed, developing nations seem to benefit the most from PPP schemes [11].

To provide a conducive PPP environment, the Indonesian Government ratified a series of PPP-related regulations. For instance, as early as 2005, a presidential regulation on "Cooperation between Government and Business Entity in Provision of Infrastructure" was

legislated. This regulation governs PPP schemes for infrastructure projects, including electricity. Generic regulations were further supported by sector-specific laws and regulations [12]. Despite the technical variations within sector-specific settings, the enacted laws and regulations reflect the widely accepted values of PPPs, such as transparency, consistency, and fairness. For example, the Indonesian PPP investors' guide [12] reiterates the golden rule of a PPP scheme that risks should be allocated to the partner with the best management ability. The allocation should be clearly defined in the contract agreement. Nevertheless, it is presumed that not all government agents are aware of and thus do not make decisions based on these principles.

Despite the Government's commendable effort, PPP schemes for electricity infrastructure projects are somewhat limited. A handful of projects reached financial closure, and the first power plant ratified in 2016 was the Central Java Power Plant (2 x 1000 MW) [13]. It suggests that PPP investment arrangements in electricity infrastructure projects have yet to gain traction.

The slow progress in PPP adoption may be attributable to the limited existence of (a) an effective partnership between the public and private entities [14], (b) a constructive relationship among all the stakeholders [14], and (c) effective communication and mutual understanding between the parties involved [15]. Within a PPP procurement setting, in particular, the limited development could be reflected by the lack of (a) a transparent and efficient procurement process [16, 17] and (b) a clear definition of risk-sharing [17].

As a PPP principally involves transferring risks from the Government to the private partners, sufficient risk identification and allocation are crucial [18]. Moreover, the proper allocation of PPP risks would minimize stakeholders' disapproval [19] and improve PPP performance [14, 20]. Accordingly, to enable a smooth and efficient process, awareness of the public/private entities' risk allocation preferences is crucial [5].

Studies on PPP risk allocation abound, as indicated in the Literature Review section. However, variations in PPP policies and methods across sectors and nations may hinder a direct translation from one context to another [6, 21]. Accordingly, risk allocation preferences in the context of Indonesian electricity infrastructure projects may not be well understood. The Literature Review section suggests that many previous studies assumed inter-party preference heterogeneity. Such studies, however, did not consider a possible intra-party divergence. Most previous empirical studies also emphasized a one-factor-at-a-time analysis of risk factors. This approach may not reflect the trade-offs among risk scenarios.

The present study attempts to address the aforementioned concerns. Moreover, the objectives of this study are threefold: (a) to identify generic PPP risk factors by conducting a literature review, (b) to identify the risk allocation preferences of public agents by considering trade-offs, and (c) to identify possible clusters of public actors with distinctive preferences and elaborate its practical implications. This study is conducted in the specific context of Indonesian PPP electricity infrastructure projects.

This study promises several contributions. Specifically, it expands the current knowledge on PPP risk preferences in a developing nation from a scientific perspective. The novel analytical method can draw unique perspectives on the realistic trade-off in PPP scenarios. From a practical perspective, this descriptive study can shed light on distinct risk preferences among government agent subgroups. Knowledge of self- and other preferences on risk-sharing could help build mutual understanding among parties involved in PPP schemes.

II. LITERATURE REVIEW

A. Empirical Studies on PPPs and Risk Allocation

This section describes previous empirical works (case study and survey) related to risk identification and allocation in PPP projects. In addition, Appendix 1 summarizes the studies by describing the country of origin, project type, research method, and the identified risk

allocation. Appendix 2 denotes the identified risk factors following the classification by Chou and Pramudawardhani [17].

1) Case Study

Qin, et al. [22] conducted a case study on PPP social infrastructure projects with local authorities in China. The study focused on the realization of PPP contracts, especially on the risk allocation aspect, and found that most risk allocation schemes written in contracts are implemented. The identified risk factors are reported in Appendix 2, while the risk allocations are described in Appendix 1.

2) Surveys

Bing, et al. [5] examined PPP risk allocation in the UK construction sector. The authors investigated risk allocation preferences via an opinion survey (convenience sampling with a 12% response rate). They identified three classes of risks (Appendix 2), namely, macro (external risk factors), meso (internal project risks), and micro (internal risks; the relationship among project elements). The respondents from private and public entities were required to choose from four risk allocation strategies, that is, allocation to the public or private entity, shared, or undecided. For each group, the dominant opinion was then determined. The results (see Appendix 1 for details) suggested that most meso-level risks should be allocated to the private sector, while a few other risks are context-dependent. The study also offered a framework for PPP risk allocation/re-allocation during contract negotiation.

Abednego and Ogunlana [20] studied perceptions of risk allocation for tollway infrastructures in the Indonesian PPP setting. The authors conducted a survey and case study, emphasizing owner/public/government perspectives. Decision-makers from PT Jasa Marga, which is a state-owned company specializing in tollway operations, represented the

respondents. The results revealed a unique financing strategy, that is, contractor prefinancing as a means of allocating financial risks between the public entity and private investors/contractors. The study also proposed a framework observing the "what," "who," "when," and "how" aspects of proper risk allocation.

Another PPP study in Indonesia was conducted by Wibowo and Mohamed [18], focusing on water supply infrastructure. The study investigated perceptions of optimal risk allocation via a mail-based survey. The respondents (n = 34, with a 25% response rate) from public and private entities were required to state their risk allocation preference for 39 identified project risks. The study found that the aggregate preferences are consistent with the normative rule of risk allocation, that is, risks should be allocated to the entity with the most capable management ability. Another important finding is the high divergence of preferences among the respondents.

Ke, et al. [15] investigated risk allocation in PPP projects in China. The authors conducted a literature review and phone interviews to extract risk information for 16 PPP projects. A two-stage Delphi survey was conducted to determine the risk allocation preferences of practitioners. Out of 203 potential respondents, 46 provided a complete response. The results suggested that nationalization and expropriation risks should be allocated to the public side. Furthermore, 12 additional government-induced risks may be borne mainly by the public, whereas private entities should take risks at the project level. No risks should be allocated solely to private partners.

Another study by Ke, et al. [23] compared risk allocation preferences in PPP projects in China, Hong Kong, the United Kingdom, and Greece. The results suggested significant differences across the nations. The public entity in the United Kingdom is the most prepared to transfer risks to private partners, followed by that in Greece, Hong Kong, and China. For macro-level risks, the respondents from Greece indicated the highest degree of preference to

retain the public sector's risks. For meso-level risks, most of the respondents from all four regions agreed with the assertion that private parties should have an increased role in bearing such risks. Furthermore, at the micro-level, the respondents from China and Hong Kong demonstrated a preference for shared risks between public and private partners. In contrast, those from Greece suggested the increased role of the private sector.

Meanwhile, Wibowo and Mohamed [24] examined Indonesian water supply PPP projects. The authors emphasized risk identification, criticality evaluation, and risk allocation in the PPP projects from regulator and operator perspectives. The authors employed a mail-based questionnaire survey (n = 30) to extract information from respondents. The authors identified four possible parties to bear the risks, namely, the Government, private investors, consumers, and insurance companies. The authors identified disagreements within and across groups in terms of risk identification and allocation. That divergence may be a key hurdle in the procurement process and contract negotiation of Indonesian PPP projects.

Abd Karim [25] developed a project matrix for Malaysia PPP Construction Projects. A series of risk factors are identified from the literature review.

A survey by San Santoso, et al. [26] emphasized risk identification, assessment, and allocation in Indonesian tollway projects. This study is among the few studies that investigated PPPs in a developing country from an investor perspective. The study calculated risk scores from two aspects: probability and impact. The study also identified the top 18 risk events. Of the 18 risk events, the respondents suggested allocating ten to the Government and seven to the private entities. However, they suggested that one risk event (i.e., weather) be shared between the two parties.

Tolani [27] conducted an empirical risk allocation study on infrastructure projects in the developing nation of Nigeria using an online survey (convenience sampling) for multiple

groups of participants. Like previous studies, by observing the probability and impact of risks, the study identified 46 risk factors. The findings suggested homogeneity in the risk perception of the respondents. This agreement across the respondents contradicts agency theory and the findings of most previous studies. The study also identified the most significant risks and their allocation, which are agreeable across the groups.

Chou and Pramudawardhani [17] conducted a comparative study on key drivers, CSFs, and risk allocation from five countries, namely, Indonesia, Taiwan, Singapore, China, and the United Kingdom. In Indonesia, the authors gathered empirical data through surveys, while data from the other nations were obtained through a literature review. The study found that (a) Indonesia and Taiwan demonstrated similarities in several key drivers, (b) Indonesia and China are similar in CSFs, and (c) Indonesia and Singapore are similar in risk allocation preferences.

Sastoque, et al. [6] conducted an interview study on social infrastructure (public school) PPP projects in Colombia. The study aimed to identify risk allocation from an aggregate of public, private, and academic experts, who were not separated during the analysis. The findings suggested that private entities may bear risks related to natural, financial, macroeconomic, construction, and operational factors. However, the public may be responsible for social, selection, and political risks.

Hilmarsson [4] assessed PPP projects focusing on the clean energy sector (e.g., hydroelectricity and geothermal) and emphasized developments in emerging/developing nations. The author provided descriptions of PPPs' positive and negative sides in clean energy projects, risk allocation, and dispute resolution.

Some studies go beyond pure empirical identification/allocation of PPP risks. The research often incorporates theory within the empirical study to produce a complete PPP framework.

Gongming [28] conducted a mixed (qualitative and quantitative) empirical study on "trust" and "risk allocation" in the context of Chinese PPP projects. The study began with a literature review to explore and formulate the possible linkage between "trust" and "risk allocation." The author conducted focus group discussions and semistructured interviews to identify PPP scenarios then developed a theoretical framework using grounded theory, which involved the analysis of social exchange. Moreover, the author employed a survey to test the hypotheses and found that (a) trust is a key driver for proper risk allocation, and (b) trust is not a moderating variable in the "risk allocation" and "contract change compensation" linkage.

Shrestha, et al. [29] proposed a comprehensive risk allocation framework based on principal-agency theory. The framework comprised 13 stages, with the underlying principle that the PPP risk should be allocated to the party with the highest management capability. Furthermore, the study considered two parties, namely, private and public entities.

From the above elaboration, PPP risk allocation studies focusing on Indonesian electricity infrastructure projects clearly do not exist. Thus, this specific domain is not well understood. Moreover, as many past studies assumed preference heterogeneity among PPP parties, most studies did not consider a possible divergence within a particular party. Furthermore, most previous empirical studies emphasized a one-factor-at-a-time analysis of risk factors, which may not reflect the trade-off in risk scenarios.

To sum up, despite variations, past empirical studies share conceptual and methodological similarities: (i) most studies take a normative approach: what had been or should be done correctly; (ii) most studies follow generic steps for risk identification, risk assessment and shortlisting, and risk allocation; (iii) primary data, either qualitative, quantitative, or both, are obtained from the field; (iv) experts from multiple project stakeholders are typically involved;

and (v) typical methods of inquiry include case studies for in-depth exploration and surveys for broad coverage.

B. Selected Key Predictors

For this study, prominent risk factors are selected from the literature review as reported in Appendix 2. Three groups of risk factors are selected, namely: "political & government policies" ("policy"), "legal aspects", and "project residual risks". In addition to frequent citations from the past literature (risk factors under "policy" are cited 42 times by critical studies, "legal": 42, and "project residual": 32), the three risk groups are selected for the high relevance for an Indonesia context. Moreover, individual risk factors representing respective groups are chosen for the high citation and contextual relevance.

Politics and government policies offer a significant backdrop to PPP initiatives in Indonesia. It is found that private sector involvement in public investment in Indonesia is deeply entangled with the political situation [10]. Since the political reform movement and the collapse of Soeharto's authoritarian regime in 1998, Indonesia has witnessed a more dynamic political environment [30]. Due to a largely democratic process, governments had regularly changed since then. Regime changes bring different political aspirations, priorities, and interests, offering a unique and perhaps challenging political context for PPP initiatives. Political stability is deemed essential for the participation of private entities [31].

Furthermore, the democratic context in Indonesia produces a powerful political opposition which, despite its general virtue, may also pose severe challenges for PPP initiatives. A strong opposition could reduce government effectiveness, which would adversely impact the determination of private sectors to invest [32].

Moreover, harsh political rhetorics on extreme nationalism and possible asset nationalization, whether they stem from ideological aspirations or simply political gimmicks during campaigns, from both ruling parties and oppositions, are not very well accepted by private entities. The

possibility of a political intervention that undermines/marginalizes the contribution of private partners in PPP is also considered an essential risk. Private investors in Indonesia may remember the restructuring of the financial system vividly amid the financial crisis [33] when failed private banks were bailed out and taken over by the Government. The bailout may be seen as a precedent for future asset takeover and nationalization.

Another politics-related PPP risk being observed in developing nations is corruption [10] which can be seen as an abuse of political power [34]. This particular PPP risk is highly relevant for the Indonesian context because the nation has been experiencing the problem for years. During the Soeharto era, for instance, corruptive motives for the participation of private sectors in public projects were observable, including those in the electricity energy sector. The government at the time introduced a PPP policy that was highly favorable for specific private firms with a solid connection to the regime [10]. The abuse of political power creates an unfair playing field for the remaining private sector with no access to power backing. The political reform in 1999 brings new hope for corruption eradication. Nevertheless, problems about corruption are yet to be addressed effectively until now.

The potential risks on political aspects and policy could also extend to the legal and regulatory aspects. When the political context changes, law and regulation are amendable. As a result, Indonesia's PPP has been experiencing constant alterations [10] in regulatory frameworks and implementations. It produces specific risks for PPP projects due to the uncertainty [35], including regulations in taxation.

Other essential PPP risks are related to the internal aspects of the projects. The capability of Indonesian contractors specializing in electricity infrastructure development varies. The less capable firms may not have an effective strategy and sufficient capability for stakeholders

engagement resulting in delays for project approval and other challenges. Other contractors may not be well-versed in project risk management [36], leading to less effective risk identification, assessment, and control.

Table 1 depicts the selected risk groups and corresponding risk factors.

Table 1 Selected Risk Factors on PPP from Key Studies

Variables or Risk Factors	Number of Citing Studies	Super Attributes or Factor Groups
Asset take-over and nationalization	7	Political & Government Policy ('Policy')
Flawed public decision-making process	4	
Powerful political opposition	4	
Corruption and bribery	2	
Changes in law and regulation	13	Legal
Changes in tax code	6	
Residual risk	6	Project Residual Risk
Delay for project approval	8	

III. RESEARCH METHOD

This study employs an experimental approach using a conjoint analysis methodology. The initial result of this methodology is reported in Ghifari [37]. Conjoint analysis is a unique multivariate statistical method that suitably serves this study's purpose. Conjoint analysis can (a) simultaneously analyze multiple variables or predictors to predict or explain the variation in the preferred risk allocations and (b) reflect realistic trade-offs among predictors. The trade-off analysis requires the respondents to make a judgment on hypothetical PPP scenarios. Thus, to form their overall PPP risk allocation preference, the respondents must simultaneously consider the favorable/unfavorable conditions of a given scenario. This approach can accurately reflect the real-life dilemmas encountered by PPP decision-makers.

This study follows the standard conjoint analysis steps suggested by [38]:

(a) The dependent variable (that is, the respondents' PPP risk allocation utility or preference) is identified. The utility value ranges from 0% (i.e., the respondent's institution should bear 0% of the risks) to 100% (i.e., full responsibility).

(b) A few but theoretically significant predictors from the literature are identified. The literature identifies a large number of potential predictors of PPP risk allocation. However, the inclusion of all potential predictors is not practically feasible, as it would increase scenario combinations, resulting in information overload for the respondents. This study follows a procedure by Hair, et al. [38] to utilize the risk factor groups as "super attributes" of the risk factors to maintain model parsimony.

(c) The levels or conditions of the super attributes are determined. As asserted previously, this study includes three super attributes in the analysis. Also, a two-level condition is defined to provide a relatively simple and easily distinguishable stimulus: (+) for a favorable condition and (–) for an unfavorable condition, as depicted in **Table 2**. A two-level condition implies a linear model, and as no existing PPP theory indicates a nonlinear association, the assumption seems justifiable. This study sets consistent levels/conditions (either favorable or unfavorable) among risk factors within respective groups. Moreover, along with the groups, the risk factors are presented to improve the experiment's clarity.

Table 2 Super Attributes, Risk Factors, and Levels

Code	Super Attributes	Code Level		Definition	
X_1	Political & Government Policy ('Policy')	X_{11}	Positive (+)	Low probability of asset take-over and nationalization	Fair public decision-making process
				Neutral political opposition	Low level of corruption and bribery
		X_{12}	Negative (-)	High probability of asset take-over and nationalization	Flawed public decision-making process
				Powerful political opposition	High level of corruption and bribery
X_2	Legal	X_{21}	Positive (+)	Law and regulation is consistent and stable	Tax code and regulation is consistent and stable
		X_{22}	Negative (-)	Law and regulation is inconsistent and unstable	Tax code and regulation is inconsistent and unstable

Code	Super Attributes	Code Level		Definition	
X_3	Project Residual Risk	X_{31}	Positive (+)	Low level of residual risk	No delay for project approval
		X_{22}	Negative (-)	High level of residual risk	Significant delay for project approvals

(d) A set of stimuli is constructed in the form of hypothetical scenarios from an orthogonal combination of the super attributes or risk groups. Accordingly, a full-factorial experiment design generates $2^3 = 8$ distinct scenarios, as reported in **Table 3.** A full-profile presentation of scenarios is chosen to reflect the real world, where the respondents could encounter all the variables simultaneously. Moreover, it entails fewer tasks for the respondents compared with a pair-wise comparison.

Table 3 Scenarios for the Design of Experiments

Scenario*	Policy	Legal	Project Risk
1	Negative	Negative	Negative
2	Positive	Negative	Negative
3	Negative	Positive	Negative
4	Positive	Positive	Negative
5	Negative	Negative	Positive
6	Positive	Negative	Positive
7	Negative	Positive	Positive
8	Positive	Positive	Positive

*Note: Negative: unfavorable condition; Positive: favorable condition

(e) Eight scenarios are translated into a set of conjoint cards, and a background story is added to reflect the controlled variables. Other questions are added for the respondents' demographic and occupational data. An online pilot study is conducted to evaluate the face validity of the instrument draft. The final version of the instrument, which passed the pilot evaluation, is then prepared for the experiment.

(f) Respondents are invited from the Coordinating Ministry for Economic Affairs, the National Planning Agency, and an energy-related state-owned enterprise, all representing the government side of the PPP scheme. An online platform is utilized for data collection.

The unit of analysis in this study is "individual decision-makers." The targeted population is PPP-related decision-makers representing the government side. Owing to the difficulty of establishing a sample frame, this study utilizes snowball convenience sampling, which may result in a sampling bias.

As mentioned previously, each respondent must perform a task to demonstrate his/her preference rating (ranging from 0% to 100%) for each of the eight hypothetical scenarios. The experiment is conducted independently (unassisted). No time limit is imposed, but respondents are required to complete all tasks in one go.

The rating reflects the respondents' individual risk allocation preference/utility for the specified PPP scenarios. For instance, a 30% rating indicates a 30% preference for allocating the overall PPP risks to his/her side. Consequently, in this preference, the private partners would bear the remaining 70% of the PPP risks, that is, 30%:70% shared risks between the public and private entities. Responses of 100% and 0% indicate that the public and private entities should be solely responsible for the risks, respectively.

(g) After data collection and cleansing, 37 datasets are obtained for the conjoint analysis. The primary analysis includes evaluating the overall fit and estimating individual utility and overall utility. Cluster analysis is performed to identify distinct patterns in individual utility and classify the respondents. Finally, the utility of the emerging clusters and the relative importance of the risk factors is identified.

IV. RESULT

A. Demographic Data

Table 4 presents the respondents' demographic data. As shown in the table, the respondents' current designation varies, with the majority currently holding a mid-management position. Furthermore, most of the respondents have 1–5 years of experience in PPP schemes.

Table 4 Demographic Data of Respondents

Designation	Respondent	Percentage
Director	3	8.10%
Manager/Head of Div.	26	70.30%
Staff	8	21.60%
Total	**37**	**100%**
Experience in PPP	**Respondent**	**Percentage**
> 10 years	5	13.50%
5 - 10 years	6	16.20%
1 - 5 years	26	70.30%
0 Tahun	N/A	0%
Total	**37**	**100%**

B. Conjoint Analysis

1) Goodness-of-Fits (GOF) Test for Individuals

Table 5 indicates the results of the GOF test for the individual respondents. The GOF in the conjoint test reflects the correlation between actual and predicted preferences. Six respondents failed the test (Respondents #1, #3, #7, #11, #29, and #33), and hence the corresponding datasets are excluded from the subsequent analysis. In the subsequent GOF test for the clusters, another dataset is removed owing to a poor fit (#13).

Table 5 Goodness-of-Fit Test for Individual Respondents

No.	Pearson's R	R-square	No.	Pearson's R	R-square
1	-	-	20	0,734	0,539
2	0,982	0,964	21	0,995	0,990
3	-	-	22	0,974	0,949
4	0,937	0,878	23	0,957	0,916
5	0,949	0,901	24	0,915	0,837
6	0,892	0,796	25	0,842	0,709
7	-	-	26	0,988	0,976
8	0,991	0,982	27	0,953	0,908
9	0,914	0,835	28	0,947	0,897

No.	Pearson's R	R-square	No.	Pearson's R	R-square
10	1	1,000	29	-	-
11	-	-	30	0,993	0,986
12	0,991	0,982	31	1	1,000
13	0,928	0,861	32	0,972	0,945
14	0,842	0,709	33	-	-
15	0,911	0,830	34	0,928	0,861
16	0,865	0,748	35	0,989	0,978
17	0,876	0,767	36	0,810	0,656
18	0,977	0,955	**37**	0,953	0,908
19	0,976	0,953			

2) Clustering

Cluster analysis is performed to observe the possible existence of distinctive groups of respondents. The cluster analysis classifies the respondents based on preference pattern similarities at the individual level. Specifically, the analysis identifies pattern similarities in the respondents' individual estimated partial utility across the three factors and base utility.

The following attributes apply to the clustering process: hierarchical agglomeration and Ward's linkage. The significant change in the agglomeration schedule is used to determine the number of clusters. Normalized data are also utilized. Two clusters of respondents emerge from the analysis, as depicted in **Table 6**. The posthoc analysis (also depicted in **Table 6**) also indicates two significantly different cluster profiles (p-value < 0.01). The t-test does not observe a significant difference in the base utility value of the two clusters. Clusters #1 and #2 consist of 16 and 15 respondents, respectively. As mentioned previously, two additional conjoint analyses are performed for the clusters.

Table 6 Descriptive Statistics of Partial Utility Estimates for Individuals (in Percentage)

Cluster #		Base Utility	Policy (+)	Policy (-)	Legal (+)	Legal (-)	Residual Risk (+)	Residual Risk (-)
1	N	16	16	16	16	16	16	16
	Mean	**43.52**	**9.92**	**-9.92**	**5.70**	**-5.70**	**7.58**	**-7.58**
	Std. Deviation	15.36	6.05	6.05	4.31	4.31	7.12	7.12
	Std. Error of Mean	3.84	1.51	1.51	1.08	1.08	1.78	1.78

Cluster #		Base Utility	Policy (+)	Policy (-)	Legal (+)	Legal (-)	Residual Risk (+)	Residual Risk (-)
	Minimum	16.25	3.75	-25.00	-2.50	-13.75	-2.50	-25.00
	Maximum	68.75	25.00	-3.75	13.75	2.50	25.00	2.50
2	N	15	15	15	15	15	15	15
	Mean	**48.50**	**-15.33**	**15.33**	**-5.67**	**5.67**	**-6.33**	**6.33**
	Std. Deviation	11.61	7.02	7.02	5.61	5.61	8.95	8.95
	Std. Error of Mean	3.00	1.81	1.81	1.45	1.45	2.31	2.31
	Minimum	35.00	-30.00	6.25	-12.50	-8.75	-31.25	-11.25
	Maximum	76.25	-6.25	30.00	8.75	12.50	11.25	31.25
Whole	N	31	31	31	31	31	31	31
	Mean	**45.93**	**-2.30**	**2.30**	**0.20**	**-0.20**	**.85**	**-.85**
	Std. Deviation	13.69	14.35	14.35	7.57	7.57	10.61	10.61
	Std. Error of Mean	2.46	2.58	2.58	1.36	1.36	1.91	1.91
	Minimum	16.25	-30.00	-25.00	-12.50	-13.75	-31.25	-25.00
	Maximum	76.25	25.00	30.00	13.75	12.50	25.00	31.25
p-value*		**0.319**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

*Note: * t-test for Clusters #1 vs. #2*

3) *Model Reproduction Quality*

Table 7 indicates the correlation coefficients of the three conjoint models. The values measure the quality of the conjoint models to reproduce the empirical datasets. The measures represent the association between the observed and estimated risk preferences. All three models indicate a high-quality reproduction of the empirical observation. The correlation coefficients and p-values of Clusters #1 and #2 are better than those of the overall respondents, thereby suggesting better model fits.

Table 7 Correlation between Empirical Data and Conjoint Estimates

	Whole Respondents		Cluster #1		Cluster #2	
	Value	Sig.	Value	Sig.	Value	Sig.
Pearson's R	0.799	0.009	0.984	.000	0.995	0.000
Kendall's tau	0.786	0.003	0.857	.001	1.000	0.000

4) Summary of Preference Estimates

Table 6 also summarizes the estimated risk preference partial values for the overall respondents and clusters. For instance, when considering Cluster #1, a favorable (positive) "Policy" condition would, on average, increase risk preference by **9.92 percentage points** from the baseline of **43.52%.** That is, the respondents are generally willing to take additional 9.92 percentage points of the PPP risks allocated to their side (in this case, the government side). In effect, the same respondents expect fewer allotted risks for their private partners in this favorable condition (the total allotted risks for the government and private sides is 100%). By contrast, when an unfavorable "Policy" condition arises, the same group's preference to take PPP risks decreases by the same percentage points (symmetrical preference). Thus, they expect their private counterparts to bear the additional risks of the unfavorable "Policy."

5) Risk Preference Profiles

Figure 1 depicts the preference profiles to bear the PPP risks for the overall respondents and Clusters #1 and #2. As the preference values of the favorable/unfavorable conditions resemble a mirror image, only the unfavorable conditions are presented.

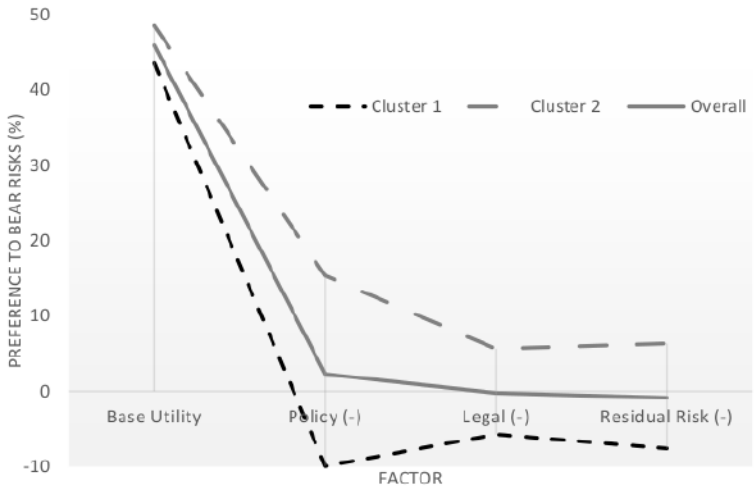

Figure 1 Profiles of Risk Preferences for the Whole Respondents and Respective Clusters for Unfavorable Settings

Figure 1 suggests similar base utility values for the overall respondents and Clusters #1 and #2, ranging from 43% to 49%. The base utility value indicates the starting point at approximately 50% of the self-allocated risks. It suggests that a base preference of a nearly balanced risk allocation between the Government and private partners. From this point, the respondents would increase/decrease the total preference depending on the partial utility.

The risk preference profile of the overall respondents, as presented in Figure 1, reflects a middle ground between the two clusters. Aside from the base utility value being close to 50%, the risk preferences for "Policy," "Legal," and "Project residual" risks are close to zero.

The clusters are further analyzed by investigating possible determinants and examining two occupational variables: designation (top- or middle-level staff) and experience (high, medium, or low). Two separate Chi-squared analyses suggest no statistical evidence to support the notion that designation or experience can predict/explain the clustering process. For "Designation," Pearson's Chi-squared p-value is 0.546, and the likelihood ratio p-value is 0.450. Meanwhile, for "Experience," Pearson's Chi-squared p-value is 0.387, and the likelihood ratio p-value is 0.378. Thus, the divided risk preference is not attributable to either job position or experience. Further research is necessary to identify the predictors.

6) Averaged Importance Score

Table 8 depicts the importance scores of the individual risk factors for the overall respondents and clusters. The scores are computed from the aggregated conjoint analysis of the group of relevant respondents. The scores indicate the relative importance (in percentages) of the risk factors in determining risk preference. The scores of Cluster #1 suggest that "Policy" is considered as the most critical PPP risk factor. Furthermore, in Cluster #1, "Policy" (the most important risk factor) is perceived as approximately $\frac{43.2\%}{25.6\%} = 1.68$ times more important than "Legal" (the least important risk factor). Cluster #2 suggests the same order of importance

as Cluster #1. However, the gap ratio between the most and least important risk factors is markedly large, that is, $\frac{55.7\%}{21.0\%} = 2.65$.

Table 8 Averaged Important Score

Risk Factor	Importance Values (%)		
	Whole	Cluster #1	Cluster #2
Policy	48.444	43.208	55.745
Residual Risk	27.855	31.152	23.220
Legal	23.701	25.641	21.035

7) Total Risk Preference for Different Scenarios

Table 9 presents the combined risk preferences for the eight scenarios of the overall respondents and Clusters #1 and #2. The aggregate preference for a scenario is computed by summating the base utility and partial risk preference for the three conditions, which form the scenario. The rank reflecting the order of the combined utility values (from largest to smallest) is also reported.

The frequency of a scenario cited by an individual as his/her top preference is also reported. In the overall respondent group, 13 respondents indicate Scenario 1 as their most preferred scenario. Scenario 1 demonstrates the highest risk preference value from 13 respondents. In the same group, the 14 remaining respondents identify Scenario 8 (the mirror image of Scenario 1) as their risk preference. An inconsistency arises when the combined utility values are computed and ranked. The combination's top two values are for Scenarios 7 and 5, which disagree with the previous notion. As noted previously, the divergence stems from the fact that the overall respondent group constitutes two markedly different clusters. A cluster-based analysis could provide an accurate picture.

Table 9 Combined Risk Allocation Preferences of Respective Scenarios

Scenario	Combined Utility Estimate (%)						Frequency**
	Base*	Policy	Legal	Residual	Total	Rank	
Whole (n=31)							
1	45.93	2.30	-0.20	-0.85	47.18	4	**13**
2	45.93	-2.30	-0.20	-0.85	42.58	8	1
3	45.93	2.30	0.20	-0.85	47.58	3	1
4	45.93	-2.30	0.20	-0.85	42.98	7	1
5	45.93	2.30	-0.20	0.85	48.87	**2**	1
6	45.93	-2.30	-0.20	0.85	44.27	6	0
7	45.93	2.30	0.20	0.85	49.27	**1**	0
8	45.93	-2.30	0.20	0.85	44.68	5	**14**
Cluster #1 (n=16)							
1	43.51	-9.92	-5.70	-7.58	20.31	8	0
2	43.51	9.92	-5.70	-7.58	40.15	5	1
3	43.51	-9.92	5.70	-7.58	31.71	7	0
4	43.51	9.92	5.70	-7.58	51.55	3	0
5	43.51	-9.92	-5.70	7.58	35.47	6	0
6	43.51	9.92	-5.70	7.58	55.31	2	0
7	43.51	-9.92	5.70	7.58	46.87	4	0
8	43.51	9.92	5.70	7.58	66.71	**1**	**15**
Cluster #2 (n=14)***							
1	48.04	15.89	5.53	6.07	75.53	**1**	**12**
2	48.04	-15.89	5.53	6.07	43.75	5	0
3	48.04	15.89	-5.53	6.07	64.47	2	1
4	48.04	-15.89	-5.53	6.07	32.69	6	0
5	48.04	15.89	5.53	-6.07	63.39	3	1
6	48.04	-15.89	5.53	-6.07	31.61	7	0
7	48.04	15.89	-5.53	-6.07	52.33	4	0
8	48.04	-15.89	-5.53	-6.07	20.55	8	0

Note: *Base utility
**frequency of a scenario being cited as a top preference by individual respondents
***one additional data point is further excluded from the analysis

The subsequent section illustrates the merits of analyzing risk preferences at the cluster level. The respondents in Cluster #1 prefer risk allocation to the government side, ranging from 20.31% (Scenario 1) to 66.71% (Scenario 8). Consistent with the previous elaboration on the partial risk preference profiles, the exact risk preference value in a particular scenario would depend on the combination of conditions. The number falls between the two extremes. Risk preferences in Cluster #2 vary from 20.55% (Scenario 8) to 75.53% (Scenario 1).

Scenario 1 (Cluster #1), which reflects a unique combination of unfavorable "Policy," "Legal," and "Project residual" risks, yields partial utility values of –9.92%, –5.70%, and –7.58%, respectively. This result indicates that for Scenario 1, the respondents, as an aggregate in Cluster #1, prefer a reduction of allotted risks by 9.92 percentage points in an unfavorable "Policy" condition, a reduction of 5.57 percentage points in an unfavorable "Legal" condition, and a reduction of 7.58 percentage points in an unfavorable "Project residual risk" condition. By adding the base value of 43.51%, the resultant risk preference is 20.31%. Thus, the respondents in Cluster #1 are willing to bear 20.31% of the overall PPP risks when encountering Scenario 1, whereas the private counterparts should shoulder the remaining 79.69% of the risks. Table 9 also indicates that Scenario 1 is considered as the least preferred scenario (rank 8) by the respondents in Cluster #1. This scenario has the lowest allotted risks for the respondents' side, thereby implying the highest risk allocation to the private partners.

However, Scenario 8 (Cluster #1) reflects a combination of risk factors yielding top risk preferences. Favorable risk factors of "Policy," "Legal," and "Project residual" risks result in the respondents from the government self-allocating 66.71% of the PPP risks. Moreover, this finding implies that 33.29% of the risks are allocated to private investors.

V. DISCUSSION AND MANAGERIAL INSIGHTS

In this section, the findings and contributions to scientific advancement are elaborated. Managerial insights are also discussed.

A. Scientific Contributions

From an academic perspective, this study offers an alternative method for eliciting risk allocation preferences in PPP projects through comprehensive trade-off evaluations. The method complements the conventional case study and survey, which most previous studies had applied. The traditional methods consider a single risk factor at a time.

Scenarios in conjoint analysis reflect a bundle of risk factors that serve as the respondents' stimuli [38]. The respondents need only to indicate their risk allocation preference as a joint evaluation of a scenario. This condition mimics decision makers' practical tasks in the risk allocation context.

The conjoint analysis also offers a satisfactory compromise between in-depth analytical outputs and increasing inquiry complications. On the one hand, the researchers require extra effort to prepare risk allocation scenarios and analyze the results, and the respondents encounter complex risk allocation tasks. On the other hand, more detailed findings can be observed compared with traditional surveys.

From only a set of respondents' answers for the scenarios, conjoint analysis can produce multiple analyses, as demonstrated earlier, including (a) evaluating the quality of model reproductions, that is, the validity of the estimated conjoint model; (b) observing the structure of risk allocation preferences, that is, the effect of level variations within a risk factor toward the formation of overall preferences; (c) evaluating risk preference profiles; (d) computing the relative importance of individual risk factors; and (e) observing the order of risk allocation preferences for a list of possible scenarios. All analyses could be observed at the individual respondent and aggregate levels. In effect, conjoint analysis can detect individual and group variations in risk preferences.

In addition, the response scale for risk allocation preferences can be presented in high resolution. A numeric scale ranging from 0% (no risk allocation to the public entity) to 100% (total risk allocation to the public entity) is utilized in this study, allowing for a detailed analysis. Past studies typically employed a three-alternative response: fully private, fully public, or shared (without specifying the exact portion).

Moreover, conjoint analysis enables a data-driven identification of clusters within a single party. Sohail, et al. [39] were among the first to highlight often diverging views across

respondent groups of users, operators, and the Government in PPP (transportation) projects. However, most past studies assumed perception heterogeneity across groups (inter-party) and thus did not investigate possible heterogeneity within a single group (intra-party). Without considering possible intra-party variations, the method would aggregate all responses under the same group. The aggregation would cancel out any variations, and the overall risk preference values would have a limited conceptual and practical meaning.

This study demonstrates the profile evaluation of the emerging two clusters vs. the overall respondents. The two emerging government clusters exhibit nearly the exact opposite profile with a nearly equal number of members. In effect, the aggregate (overall) risk profile reflects the diluted average scores of the two clusters, that is, the scores are consistently close to zero (see Table 6 and Figure 1 for 'Overall'). Referring to the diluted scores, scholars may end up with a misleading conclusion that Indonesian respondents from public entities exhibit indifference toward risk factors in the risk allocation decision-making process.

The analysis also produces a validated predictive model. The model could help forecast the PPP risk preferences of a particular cluster, given a known scenario.

The utilization of the conjoint analysis method for risk elicitation reveals findings from unique managerial perspectives, which are described below.

B. Managerial Insights

This study provides managers with detailed descriptions of how the Indonesia PPP decision-makers perceive and eventually make risk-sharing and allocation decisions. This study explains perceived risk preferences 'as they are' (descriptive) instead of 'as they should be' (prescriptive).

This study shows that the two government clusters exhibit sharp and distinct risk preference profiles. The more accommodative cluster (i.e., Cluster #2) indicates a willingness to bear an additional percentage of risks in the face of unfavorable conditions ("Policy," "Legal," and

"Project residual" risks). The less accommodating cluster (Cluster #1) prefers reducing the risk-sharing percentage for its side when faced with unfavorable risk factors.

This study also observes distinct risk allocation preferences in the clusters for the different scenarios (i.e., a combination of risk factors). The most preferred scenario of Cluster #1 is Scenario 8, whereas that of Cluster #2 is Scenario 1 (Table 9). The most preferred scenario indicates the respondents' willingness to bear the highest risks relative to the other scenarios. Interestingly, Scenario 8 reflects the exact opposite condition of Scenario 1. In other words, the respondents from the Government in Cluster #1 (the less accommodative cluster) are willing to bear the highest risks in a scenario when all three risk factors ("Policy," "Legal," and "Project residual" risks) are generally favorable. By contrast, the government respondents in Cluster #2 (the more accommodative cluster) are willing to allocate the highest risk portion score to their side when faced with a scenario with all unfavorable risk factor conditions.

A challenge for the Government and private entities in Indonesian PPPs may come from the above revelations. This divergence may negatively affect the Government's approach to PPP regulation development and implementation. Studies on team diversity and conflict management suggested that mindset polarization may create disagreements and tension [40, 41]. If not appropriately managed, interpersonal tension could damage team cohesion and increase adverse conflicts, which in turn can reduce team performance [42-44]. Increased conflicts may be detrimental to government agents' internal deliberation process during the development of PPP regulatory frameworks. The conflict may cause delays in the approval and ratification of PPP regulations.

Private partners may also be affected by the aforementioned problem. Given the differing internal opinions and delays on the government side, private partners may perceive their government counterparts to be (a) inconsistent in PPP policy and decision making or (b) not working efficiently to reach an agreement and close the deal. In extreme circumstances, private

entities may perceive this inconsistency and delay as the Government's lack of commitment to fair and proper PPP arrangements, resulting in the complete withdrawal of the private sector from the PPP process.

Furthermore, the cluster findings offer compelling evidence for the possible problem encountered by managers. Private partners should not presume that their government counterpart is homogeneous. Depending on the Government's team composition and dynamics, private partners may experience different interactions throughout the process. For instance, they could deal with more accommodating partners in one stage but have to address less accommodating public agents in another phase.

For private entities, agents with different risk preferences require different communication and negotiation strategies. For instance, when the government counterpart comprises less accommodating individuals, a manager may need to employ an aggressive negotiation strategy to assert optimal PPP risks. The cluster analyses (Table 9) offer an estimation of public agents' initial risk preferences for private partners, given a set of circumstances. Private entities may adjust their negotiation strategy according to the prediction to determine an optimal risk-sharing arrangement.

The study also reveals that the government responses from both clusters do not consistently comply with the PPP risk allocation "golden rule." The fundamental principle of proper risk allocation is that the risk factors should be allocated to the party with the best management ability [20, 24]. This ability includes assessing/controlling/managing risks, accessing hedging instruments, and diversifying and efficiently absorbing risks [18]. Past studies translate the golden rule to risk classifications and suggested risk allocations. Bing, et al. [5] proposed three risk classes, namely, macro (external risk factors), meso (internal project risks), and micro (internal risks; the relationship among project elements), and asserted that meso-level risks should be allocated to private entities. A comparative study of four nations by Ke, et al. [23]

determined that macro-level risks should be borne by the public sector (Greek respondents). In contrast, meso-level risks should be allocated to private entities (all four nations), and micro-level risks should be shared by the two parties (China and Hong Kong) or allocated to the private sector (Greece).

Following the golden rule and translation of past findings, it is expected that the government respondents in this study to have the following preferences for optimal risk-sharing:

(a) Policy risks, which are part of the macro level: an inclination toward the Government

(b) Legal risks, which are part of the macro level: an inclination toward the Government

(c) Project residual risks, which are part of the meso level: an inclination toward private entities

This study (Table 6) reveals that the respondents in Cluster #1 seem to adopt Preference (c) but do not comply with Preferences (a) and (b). As mentioned previously, Cluster #1 (the less accommodative cluster) tends to transfer all three (unfavorable) risks into the private partners. Meanwhile, Cluster #2 seems to follow Preferences (a) and (b) but does not meet Preference (c). Cluster #2 (the more accommodative group) prefers to bear all three (unfavorable) risks. Thus, it is determined that the preference of both groups has yet to reflect a proper risk allocation scheme. If the risk allocation preferences in this study genuinely reflect the standing of government representatives, achieving an agreed-upon and optimal risk-sharing contract scheme would be difficult.

This study identifies practical takeaways for PPP public practitioners in Indonesian electricity investment projects to improve their chances of success from the above observations.

Awareness of the risk preference heterogeneity of the government entity is crucial. For public leaders responsible for governing PPPs, this finding serves as a wake-up call to promote constructive discussions to connect clusters of government agents with different risk allocation

preferences. Moreover, public leaders should be aware that the fundamental principles of fair risk-sharing (i.e., the golden rule) are not widely understood among government agents. Hence, leaders must advocate optimal risk-sharing.

Furthermore, government agents involved in the PPP regulatory development and procurement process must be equipped with sufficient knowledge, skills, and tools for devising a proper risk-sharing scheme. This need for public agent training on PPPs was emphasized in recent studies (e.g., [45]). For the respondents in Cluster #1 (the less accommodative cluster), such training would emphasize fostering a risk-taking attitude, which often runs counter to the traditional bureaucratic thinking of government agents. Tiong, et al. [46] asserted that a calculated risk-taking attitude is crucial for achieving superior PPP project performance. Thus, the main message for Cluster #1 is that *not* all PPP risk factors can be optimally transferred to private partners. This message echoes the best practice identified by Wibowo and Mohamed [18], that is, optimum risk sharing is typically better than maximum risk transfer from the public to a private entity.

VI. CONCLUSION

This study explores the risk allocation preferences of public agents in Indonesian PPP electricity infrastructure projects. From the literature review, three groups of risk factors are identified, namely: "Policy," "Legal," and "Project residual" risks. The conjoint analysis methodology offers a novel perspective for observing PPP trade-off scenarios of combining the three risk factors. In addition, the method facilitates a more detailed quantitative analysis compared with typical surveys.

Apart from the methodological contribution, this study broadens current knowledge on PPP risk-sharing preferences, especially in the context of a developing nation. This study describes how public agents perceive risk allocation. Two distinct clusters within a single party (public entity/Government) emerge. This study extends the fact that different parties can have

distinctive preferences. The two clusters agree on the order of importance but disagree on nearly everything else. The clusters diverge in terms of the magnitude of risk importance. They also differ in risk preference scores and profiles and their most preferred scenarios. In addition, this study determines that both clusters' risk profiles do not consistently follow the golden rule of optimum risk sharing.

It is asserted that awareness of the heterogeneity of public agents' risk preferences is crucial for PPP project success. For public leaders supervising public agents, the findings can serve as a reminder to bridge internal differences during the establishment of PPP regulatory frameworks and implementation phase. Moreover, leaders must equip agents with the proper knowledge and tools for making optimum risk-sharing decisions. By doing so, public agents involved in the PPP process could project a positive image of united, committed, and rational decision-makers to the other stakeholders. For private entities contemplating a PPP in electricity infrastructure projects in Indonesia, the clusters and scenarios can offer detailed information on their government counterpart's risk allocation preferences. This information is helpful for preparation and anticipation during the PPP process and contract negotiation. Finally, the findings can enhance mutual understanding between public and private partners. This, in turn, would enable an expeditious PPP regulatory development, successful partnerships, and project performance [20].

Although the implementation of the specific results of this study is somewhat limited to the Indonesian PPP setting, the generic insights offer essential takeaways for PPP practitioners in different contexts. First, this study finds that government representatives do not have the same perceptions and hence do not act in unison. Accordingly, assuming homogeneous preferences across party members is problematic. Second, this study demonstrates that the respondents' preferences do not consistently reflect the optimal PPP risk-sharing principles. All parties involved in the PPP process should acknowledge this possible bias and work together in its

reduction. Understanding the situation may become part of a broad practice to promote a transparent PPP process.

However, this study has several limitations. First, this study identified risk factors from secondary data through a literature review. While the referred literature is deemed comprehensive, recent, and relevant to the Indonesian context, it may lack specificity in electricity infrastructure projects. Second, the utilization of conjoint analysis prevents this study from utilizing a large number of risk factors. This study uses three super attributes to combine multiple risk factors while maintaining the simplicity of conjoint scenarios. However, many key risk factors are excluded from the analysis. The third limitation is typical in experimental studies involving human subjects. As the scenarios are hypothetical, a legitimate concern exists on whether the respondents would consider the exercise seriously and respond to the stimuli candidly, concerned with external validity [47].

This study also identifies possible follow-up research. First, conjoint studies emphasizing the preferences of respondents from the private sector are necessary. Such studies would augment the current insights to create a complete picture of public–private risk preferences in Indonesian electricity PPP projects. Comparative conjoint analysis between private and public preferences could reveal possible cognitive gaps within and between PPP parties. The results may be used as a reference to narrow such gaps. Second, studies examining predictors that shape risk allocation preference clusters are also necessary. Such studies help observe respondents' attitudes, perceptions, and motivations toward risk allocation preferences. Understanding risk attitudes and motivations is crucial to develop a practical educational approach and tool for training PPP decision-makers on optimal risk allocation.

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Appendix 1 Summary of Key Studies

No	Author, year	Country	Project Type	Research Method	Risk Allocation
[A]	Qin, Y., Ding, X., and Chen, C. (2019)	China	PPP road & pipe gallery	Case study	3 options of Risk Allocation: 1. Undertaken by local government 2. Undertaken by private sector 3. Jointly undertaken Mostly, undertaken by private sectors (23 out of 35 identified risks)
[B]	Bing, L., Akintoye, A., Edwards, P.J., and Hardcastle, C. (2005)	UK	PPP/PFI Construction projects	Questionnaire survey (3 parts): 1.Background 2.Issues PPP/PFI projects 3.Risk & risk management	3 Risk allocation: 1. Public sector → site availability & political risks 2. Private sector →remaining risks, 32 out of 46 risk factors (70%) should be assigned to the private sector 3. Shared risk → relationship risks, force majeure risks, and risks of legislation changes 4. Allocation depends on specific circumstances→ case-by-case basis. Such as: a. Level of public support b. Project approval & permits c. Contract variation d. Lack of experience
[C]	Abednego, M.P. and Ogunlana, S.O. (2006)	**Indonesia**	PPP tollway	Case study, questionnaire, supported by interviews with the owner's (PT. Jasa Marga)	Applying "Who-What-How-When" risk allocation concept. Determine **who** has the best capability to accept the risk (**what**), the **when** and **how** factors should be considered.
[D]	Wibowo, A., and Mohamed, S. (2008)	**Indonesia**	PPP water supply projects	Mail-based questionnaire to the industry practitioners	**1. Political risk** → mostly undertaken by **Government**, except for: a. Non availability of FX b. Transferability restriction of FX c. Exchangeability restriction of FX 1a, 1b, 1c undertaken by **private sector** **2. Macroeconomic risk** → mostly undertaken by **Private sector,** except for: **a.** Interest rate fluctuation → undertaken booth between **Government & Private sector** **3. Production-Related risk** → mostly undertaken by **Private,** except for: a. Nonavailability of raw water b. Env't protest causing interruption c. Low quality of raw water d. Water meter manipulation 3a,3b,3c →undertaken by **Government** 3d→undertaken by **Consumer** **4. Force-Majeur Risk** → mostly undertaken by **Government**, except for:

					a. Manmade disaster b. Labor strike 4a→undertaken by **Insurance** 4b→**Private** 5. **Project-Related risk** → mostly undertaken by **Private**, except for: a. Land cost escalation b. Protracted negotiation on land price 5a,5b →**Government** 6. **Business risk** → mostly undertaken by **Private**, except for: a. Tariff uncertainty b. Abuse of power by Gov't officials c. Unpaid bills by consumers
[E]	Ke, Y., Wang, S.Q., Chan, A.P.C., and Lam, P.T.I. (2010)	China	Various PPP projects (Treatment plant, Water Plant, Power Plant, Waste-to-Energy Plant, Bridge, Tunnel, Expressway)	Literature review & telephone interview with practitioners	Risk Allocation: 1. RF no.1 → solely allocated to the public sector 2. RF no.2-13 → mostly allocated to the public sector 3. RF no.14-28 → shared by both public & private sector 4. RF no.29-38 → mostly allocated to the private sector
[F]	Ke,Y., Wang, S.Q., and Chan, A.P. (2010)	China & Hong Kong vs UK & Greece	PPP Infrastructure projects	Comparative study by a questionnaire survey	1. Public sector in UK was most able to transfer the PPP risks to the private sector, followed by Greece>Hong Kong>China. 2. Macrolevel risks mostly undertaken by public sector in Greece. 3. Mesolevel risks should be undertaken by private investors in 4 countries. 4. Microlevel risks should be shared equally between public & private sectors in China & Hongkong, but it should undertaken more by the private sector in Greece.
[G]	Wibowo, A., and Mohamed, S. (2010)	**Indonesia**	Privatised water supply projects	Mail-based questionnaire survey from regulators & operators, and measure the Index of Diversity (ID) in each risk factors (with score >0,50)	**1. Government retaining 8 risk factors:** 1.1 Discriminatory changes in legislation 1.2 Specific changes in legislation 1.3Nationalization/Expropriation 1.4 Abuse of power by government officials 1.5 Declared war 1.6 Terrorism attack 1.7 Non-availability of raw water 1.8 Environment protest caused interruption **2. Operators retaining 7 risk factors:** 2.1 Construction time overrun 2.2 Non availability of FX 2.3 Transferabilty restriction of FX 2.4 Breach of contract by operator

					2.5 Premature termination by operator 2.6 Failure in financial closure 2.7 Failure in refinancing **3. Consumers retaining 1 risk factors:** 3.1 Water meter manipulation
[H]	Karim, N.A.A. (2011) [5]	Malaysia	PPP Construction Project	Matrix mapping from literature review	*Did not specifically mentioned in the paper.*
[I]	Santoso, D.S., Joewono, T.B., Wibowo, A., Sinaga, H.P.A., and Santosa, W. (2012)	**Indonesia**	PPP Tollway Construction and Operation	Risk assessment survey of tollway companies → then generate with value-of-risk index	Risk Allocation undertaken by: 1. Government (Public sector): 1.1 Land acquisition or site availability 1.2 Approval & permit by government 1.3 Gov't reliability 1.4 Increment of toll fee 2. Investor (Private sector): 2.1 Operational income 2.2 Availability of finance 2.3 Construction cost overrun 2.4 Construction time completion 2.5 Inflation rate 2.6 Interest rate 3. Shared (Public & Private sector) 3.1 Weather
[J]	Tolani, O. (2013) [5]	Nigeria	Several PPP (Banking, Construction, Public Sector)	Online survey from practitioners (banking, construction, public sectors)	Risk allocation preferences: 1. Private sector 59% (27 out of 46 risk factors) → RF no.1 to 27 2. Equally shared 24% (11 out of 46)→ RF no. 28-38 3. Public sector 17% (8 out of 46) → RF no. 39-46 [2]
[K]	Chou, J.-S., and Pramudawardhani, D. (2015) [19]	Cross-country comparisons: 1. Taiwan 2. Singapore 3. China 4. UK 5. Indonesia	Various PPP projects	Data collection: 1. Literature review (data for Taiwan, Singapore, China, UK) 2. Survey (data for Indonesia) Analysis Methods: 1. Mean Value Analysis 2. Confirmatory Factor Analysis 3. Dimensional Importance	Considering Indonesia as the baseline, Singapore exhibits the most similarity with Indonesia in terms of risk allocation→ which tend to share risks among both parties (private & public sector). 1. Private sector takes most responsibility→1 social risk factor, 2 project finance risk factors, 1 residual design deficiency, 1 operation risk, 2 third party risk factors, 1 unidentified. 2. Both sectors→1 political risk factor, 1 legal risk, 1 social risk, 1 project finance, 2 residual risk design, 2 relationship risk, 4 unidentified risks. 3. Public sector→ 2 risk factors related political & gov.policy
[L]	Sastoque, L.M., Arboleda, C.A., and Ponz, J.L. (2016)	Colombia	PPP Public School	1. Risk identification & selection → literature review	Risk Allocation: 1. Private Sector: 1.1 Natural risk 1.2 Financial risk 1.3 Macroeconomic risk

				2. Risk allocation → interview with practitioners & academicians	1.4 Construction risk 1.5 Operational risk 2. Public Sector 2.1 Social risk 2.2 Selection project risk 2.3 Political riks 3. Shared Private & Public Sector 3.1 Legal & legislation risk 3.2 Residual risk 3.3 Relationship risk
[M]	Hilmarsson, H.Þ. (2017)	Developing and Emerging Countries	Review PPP in Clean Energy Investments (Geothermal & Hydropower)	Literature review & author's notion	• For Build-Operate-Transfer (BOT) scheme, private sector is responsible for financing, constructing, and operating the projects. • Completion & performance risk should be allocated to the construction contractor (private sector). • Changing policy & political risk should be undertaken by Government (public). • Sharing risk during the economic & financial crisis.
[N]	Gongming, M. (2018)	China	PPP Construction	Combining qualitative (literature) & quantitative (survey) analysis	• This research found that the influence of risk allocation embedded in contract flexibility on the realization of contract state compensation is not sensitive to the relationship situation. • Trust and proper risk allocation embedded in contract flexibility both have positive influence on risk re-allocation under contract state compensation.
[O]	Shrestha, A., Tamošaitienė, J., Martek, I., Hosseini, M.R., and Edwards, D.J. (2019)	-	General PPP	Literature review	• Private sectors maybe better suited to manage endogenous risk. • Government's undertaken uncertainties from exogeneous risks. • Sharing risk mechanism may involve: • Revenue guarantees • Interest rate guarantees • Force majeure • Demand for services

Appendix 2 PPP Risk Factors according to Key Studies

No	Factor Group	Code	Risk Factor	A**	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Freq.
1	Political and government policy	RA1	Unstable government		*			*					*	*					4
		RA2	Expropriation or nationalization of assets		*		*	*		*		*	*	*					7
		RA3	Poor public decision-making process	*	*								*	*					4
		RA4	Strong political opposition/hostility		*			*					*	*					4
		RA5	Lack of support from government											*					1
		RA6	Corruption and bribery											*	*				2
		RA7	Government's intervention				*			*				*					3
		RA8	Government's reliability			*					*	*		*		*		*	6
		RA9	Withdrawal of government support network				*			*				*				*	4
		RA10	Termination of concession by government	*		*	*	*		*				*		*			7
2	Macroeconomic	RA11	Inflation rate volatility	*	*	*	*	*	*	*		*	*	*	*		*	*	13
		RA12	Interest rate volatility	*	*	*	*	*	*	*		*	*	*	*				11
		RA13	Influential economic events	*	*			*	*				*	*	*	*			8
		RA14	Foreign exchange and convertibility	*			*	*		*		*		*	*				7
		RA15	Financial risk		*	*	*	*	*	*	*		*	*		*	*		11
3	Legal	RA16	Legislation change	*	*		*	*	*	*		*	*	*	*	*	*	*	13
		RA17	Change in tax regulation		*	*			*				*	*	*				6
		RA18	Industrial regulatory change		*			*	*			*	*	*	*				7
		RA19	Lack of legal/regulatory framework									*		*	*	*			4
		RA20	Excessive contract variation	*		*			*				*	*					5
		RA21	Immature juristic system							*				*					2
		RA22	Improper contract			*		*						*	*				4
		RA23	Lack of standard model for PPP agreement						*				*	*	*				4
4	Social	RA24	Lack of tradition of private provision of public services		*				*			*	*	*					5

No	Factor Group	Code	Risk Factor	A**	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Freq.
		RA25	Level of public opposition to project		*		*		*	*	*	*	*	*	*				9
		RA26	Market demand change		*		*			*	*	*	*	*	*				8
5	Natural	RA27	Force majeure	*	*	*	*	*		*	*	*	*	*	*			*	12
		RA28	Geotechnical conditions	*	*	*		*	*				*	*	*				8
		RA29	Weather		*	*	*	*	*		*	*	*	*					9
		RA30	Environment		*	*	*	*	*	*	*	*	*	*					10
6	Project selection	RA31	Land acquisition (site availability)	*	*	*	*	*	*	*		*	*	*				*	11
		RA32	Uncompetitive tender								*			*	*			*	4
7	Project finance	RA33	Availability in finance	*	*	*	*	*	*		*	*	*	*	*		*	*	13
		RA34	Financial attraction of project to investors		*				*		*		*	*					5
		RA35	High finance costs	*	*		*	*			*	*	*	*					8
8	Residual risk design	RA36	Residual risks		*			*	*				*	*	*				6
		RA37	Delay in project approvals and permits		*			*	*			*	*	*	*			*	8
		RA38	Design deficiency		*	*		*	*			*	*	*					7
		RA39	Unproven engineering techniques		*			*					*	*					4
		RA40	Scope variation		*			*						*	*		*		5
		RA41	Supporting facilities risk					*						*					2
9	Construction	RA42	Construction cost overrun	*	*	*	*	*		*		*	*	*	*				10
		RA43	Construction time delay	*	*	*	*	*		*		*	*	*	*				10
		RA44	Material/labor availability	*	*			*				*	*	*	*				7
		RA45	Poor quality workmanship	*	*	*		*		*		*	*	*					8
		RA46	Insolvency/default of sub-contractors or suppliers		*	*		*		*		*	*	*	*				8
		RA47	Site safety and security	*		*		*				*		*	*				6
10	Operation	RA48	Operation cost overrun	*	*		*	*		*		*	*	*	*				9
		RA49	Operational revenues below expectation		*			*				*	*	*					5
		RA50	Low operating productivity	*	*			*					*	*					5
		RA51	Maintenance costs higher than expected	*	*			*					*	*					5

No	Factor Group	Code	Risk Factor	A**	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Freq.
		RA52	Maintenance more frequent than expected	*	*		*	*					*	*					6
		RA53	Technological risk				*			*		*		*					4
		RA54	Operation default	*			*	*		*		*		*			*		7
11	Relationship	RA55	Organization and co-ordination risk		*	*			*		*	*	*	*	*		*	*	10
		RA56	Inadequate distribution of responsibilities and risks		*				*			*	*	*			*	*	7
		RA57	Inadequate distribution of authority in partnership	*	*			*	*		*	*	*	*			*		9
		RA58	Differences in working method and know-how between partners		*				*		*		*	*			*		6
		RA59	Lack of commitment from either partner	*	*		*		*		*	*	*	*			*		9
		RA60	Private investor change											*					1
12	Third party	RA61	Third Party Tort Liability		*			*	*		*	*	*	*		*		*	9
		RA62	Staff Crises		*			*	*	*	*		*	*					7
13	Unidentified	RA63	Competition (exclusive right)			*	*			*	*	*		*				*	7
		RA64	Tariff change			*	*			*	*			*			*		6
		RA65	Payment risk	*			*			*		*		*					5
		RA66	Lack of consortium expertise								*		*	*					3
		RA67	Subjective evaluation											*			*		2
		RA68	Insufficient financial audit											*					1
		RA69	Construction/operation change	*	*							*		*					4

Note: *: the risk factor is reported by a study; Freq.: the number of references which cite a risk factor

- The appendix follows the structure and classification by Chou and Pramudawardani (2015)`
- Shaded columns denote Indonesian PPP proejcts

** Selected key studies:

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