ISSN 0853-2982 eISSN 2549-2659

JURNAL TEKNIK SIPIL

Jurnal Teoretis dan Terapan Bidang Rekayasa Sipil

Construction Performance Analysis in the Project Delivery of Toll Road Concession

Roi Milyardi(*)

Civil Engineering Master Program, Bandung Institute of Technology
E-mail: roi.milyardi@student.itb.ac.id

Reini D. Wirahadikusumah

Civil Engineering Master Program, Bandung Institute of Technology

Muhamad Abduh

Civil Engineering Master Program, Bandung Institute of Technology

Budi H. Siregar

Civil Engineering Master Program, Bandung Institute of Technology

Abstract

PPP scheme has stimulate increasing the volume of infrastructure development in Indonesia from the period of 2014 and planned until 2025, where the toll road business is carried out by business entities with a concession period. In the PPP scheme, various variables need to be considered, including project cost, project complexity, strong public support, and performance indicators in each phase of toll road concession. The construction phase in the PPP scheme in Indonesia is the responsibility of the business entity regulated in PP No. 43 of 2013. Determination of project delivery on toll road construction projects is a strategy of the business entity to control the performance of the toll road construction project it manages. In the complexity of the variables in PPP, a variable pattern with project delivery is needed to find an effective strategy in achieving good construction performance. The purpose of this study is to identify patterns of achievement of construction performance on variations in project delivery in the toll road PPP scheme. The analytical approach QCA (Qualitative Comparative Analysis) is taken, with 14 BUJT case studies in 4 toll road networks in Indonesia. From the results of the study, two project deliveries, design-bid-build and design & build, were identified, which identified that project delivery variations did not have a strong influence on the performance of toll road construction projects, where other toll road PPP concession, such as business scheme, project management maturity, construction cost, length of road, corporation relation between business entities and contractor contractor's financial scheme, and land acquisition scheme variables which is more powerful.

Keywords: Project delivery, performance, construction project, toll road, qualitative comparative analysis

Abstrak

Meningkatnya volume pembangunan infrastruktur di Indonesia pada periode 2014 dan direncanakan hingga tahun 2025 didorong dengan skema KPBU, dimana pengusahaan jalan tol dilakukan badan usaha dengan timbal balik suatu masa konsesi. Dalam skema KPBU, berbagai variabel perlu diperhatikan, diantaranya biaya proyek, kompleksitas proyek, dukungan publik yang kuat, hingga indikator kinerja pada setiap fase pengusahaan jalan tol. Fase konstruksi pada skema KPBU di Indonesia, menjadi tanggung jawab badan usaha yang diatur dalam PP No.43 Tahun 2013. Penentuan project delivery pada proyek konstruksi jalan tol menjadi strategi badan usaha mengendalikan kinerja proyek kosntruksi jalan tol yang dikelolanya. Dengan kompleksitas variabel dalam KPBU, diperlukan pola variabel dengan project delivery agar ditemukan strategi yang efektif dalam mencapai kinerja konstruksi yang baik. Tujuan dari penelitian ini adalah mengidentifikasi pola capaian kinerja konstruksi pada variasi project delivery di skema KPBU jalan tol. Pendekatan analisis yang dilakukan adalah QCA (Qualitative Comparative Analysis), dengan 14 studi kasus BUJT di 4 jaringan jalan tol di Indonesia. Dari hasil penelitian, diidentifikasi bahwa variasi project delivery tidak berpengaruh secara kuat terhadap capaian kinerja proyek konstruksi jalan tol. Kinerja konstruksi jalan tol lebih kuat dipengaruhi oleh variabel-variabel pengusahaan KPBU jalan tol lainnya, yaitu skema pengusahaan, maturitas manajemen proyek, biaya konstruksi, panjang jalan, skema finansial kontraktor, hubungan korporasi BUJT-korporasi, dan skema pengadaan tanah.

Kata-kata Kunci: Project delivery, kinerja, proyek konstruksi, jalan tol, qualitative comparative analysis

**Correspondence Author*

Diterima 22 Juli 2019, Direvisi 13 Maret 2020, Diterima untuk dipublikasikan 14 April 2020

1. Introduction

Toll roads are one of the infrastructures that drive economic growth. The Indonesian Government, from 2014 until 2019, prioritized toll road infrastructure development. The realization of toll road development in Indonesia in the 2014-2018 period increased significantly compared to the previous years and is planned to continue until 2025 according to BPJT data in **Figure 1**. The significant increase in toll road development in Indonesia cannot be separated from the role of business investment through the PPP (Public-Private Partnership) scheme regulated in Law no. 38 of 2004. In managing toll roads, the government through the Toll Road Regulatory Agency/BPJT encourages investment in the toll road sector so that the development of the toll road network can be realized more quickly. However, in the implementation of the PPP that has been done, there are 68 toll roads recorded that are managed by 50 Toll Road Business Entities/BUJT with diverse company backgrounds (BPJT, 2019). Besides PT. Jasa Marga as the oldest toll road operator in Indonesia, various SOE companies from the construction sector, regionally-owned enterprises, to non-construction companies become the largest shareholders as shown by the toll road management business profile data in the construction phase in 2018 in **Figure 2**.

In the PPP scheme, various variables need to be considered. Federal Highway Administration (FHWA) (2010) identified characteristic factors of toll road projects that are important to note in the PPP scheme, namely the construction cost, project complexity, strong public support, and source of income. The construction phase needs special attention because it is the biggest threat in the PPP scheme, because it can raise the risk of additional investment costs in the form of unexpected construction costs (Price water house Coopers Advisory S.p.A., 2014). Meanwhile, the World Bank (2000) identified the importance of performance indicators in each phase, from the funding performance indicator to the operating performance indicator, in the toll road PPP scheme concession. In practice, the performance of toll road construction projects with the PPP scheme has several problems, including project delays, construction accidents, and the construction quality achievement that has not been achieved properly ((Tirto, 2018) (Kontan, 2016) (Detik Finance, 2019)). The construction phase in the PPP scheme is the full responsibility of the business entity regulated in the Government Regulation No. 43 of 2013 concerning toll roads. The determination of project delivery in toll road construction projects has become one of the strategies by business entities to control the performance of toll road construction projects that they manage. Koppinen & Lahdenperä (2004) identified that project delivery affects the construction performance. Of course, with the complexity of variables in the PPP, a variable pattern with project delivery is necessary in order to find the most effective strategy in achieving good construction performance for the construction progress now and in the future. In this research, a case study was carried out on 14 toll road PPP scheme projects that aimed at obtaining a pattern of toll road concession variables in relation to project delivery on construction performance.

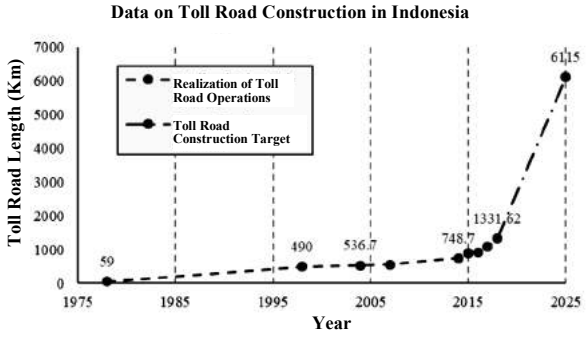

Figure1. Data on toll roads operating in Indonesia (BPJT, 2007 and 2018)

Investor profile of the Toll Road Business Entity in the construction phase of 2018

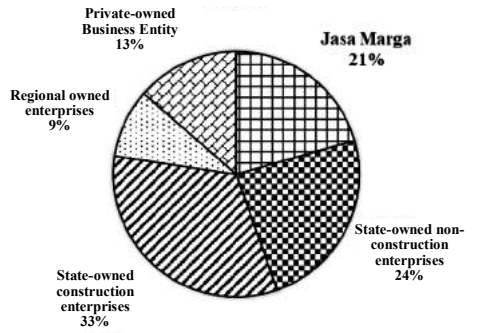

Figure2. Profile of toll road business in the construction phase in 2018 (BPJT, 2018)

2. Literature Review

2.1 Concession and toll road project delivery

PPP (Public private Partnership*)* scheme is one of toll road concession schemes. The PPP scheme encourages infrastructure development with high costs and limited budget of a country by using the toll road management and funding scheme by involving private parties (PricewaterhouseCoopers Advisory S.p.A., 2014). The toll road PPP scheme is generally carried out by a business entity. Business entities are in the prime position in the toll road concession contract network involving the government, investors, planners, contractors, operators and road users, as shown in **Figure 3**.

Toll road PPP scheme concessions in Indonesia are regulated in Law no. 38 of 2004 concerning roads and Government Regulation No. 30 of 2017 concerning toll roads. The PPP scheme is divided into several sub-schemes that are determined based on an analysis of economic feasibility, financial feasibility, and the purpose of developing an area, as shown in **Figure 4**. Generally, there are 3 PPP sub-schemes, namely BOT, S-BOT, and SOE assignments involving business

Diterima 22 Juli 2019, Direvisi 13 Maret 2020, Diterima untuk dipublikasikan 14 April 2020

entities that are determined based on economic and financial feasibility.

In the practice in Indonesia, Toll Road Business Entities (*Badan Usaha Jalan Tol*/BUJT) are dominated by a subsidiary or having a corporate relationship with construction contractor companies, which have no experience in the toll road business. It is interesting to further investigate the effect of the corporate relationship between BUJT and the implementing contractor, bearing in mind that the construction project is carried out by the implementing contractor who has a position as a parent entity, to see the effect of coordination of the corporate relationship on construction performance.

Meanwhile, the project delivery of toll road projects in Indonesia isn't specially regulated, based on Government Regulation no. 43 of 2013, the construction phase is entirely the decision of the BUJT business company with consideration of quality, efficiency and benefits, as well as the function of the toll road. Koppinen & Lahdenperä (2004) in their research found that project delivery of toll road projects is very closely related to the performance of construction projects, where the variation of advanced (collaborative) project delivery provides better construction project performance, so that this study, in addition to reviewing the project delivery system at the toll road project level, also reviewed the toll road PPP scheme concession in relation to construction project performance.

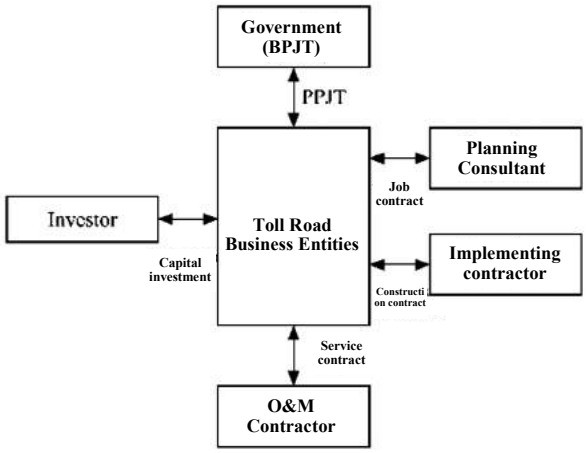

Figure 3. PPP scheme business entity contract network
(Engel, Fischer, & Galetovic, 2010)

2.2 Construction project performance

As a finding from (World Bank, 2000) that performance indicators are an important factor in the PPP scheme, the performance in the construction phase is also important in a toll road construction project. Construction project performance measurements are needed to reflect the needs and expectations of all stakeholders, but the performance of stakeholders also needs to be measured during the project phase to ensure there are no conflicts, disputes, and blaming syndromes during the project completion stage (A.S. Pillai, 2002). Takim & Akintoye (2002) identified indicators that are important to note in a construction project from the results of the study of literature from some previous researches, among them are customer satisfaction, quality, productivity, profitability, financial, cost, time, occupational health and safety (OHS), and environment.

To measure the performance of a construction project, a measurement instrument that can measure performance indicators of a construction project is needed. Nassar (2009) developed an integrated system of performance measurement in construction projects consisting of indicators of cost, time, payment, profitability, OHS, quality, project team satisfaction, and customer satisfaction. The construction project performance measurement system is measured quantitatively. The quantitative measurement of the performance of a construction project is measured in a performance index with certain calculations. Schedule

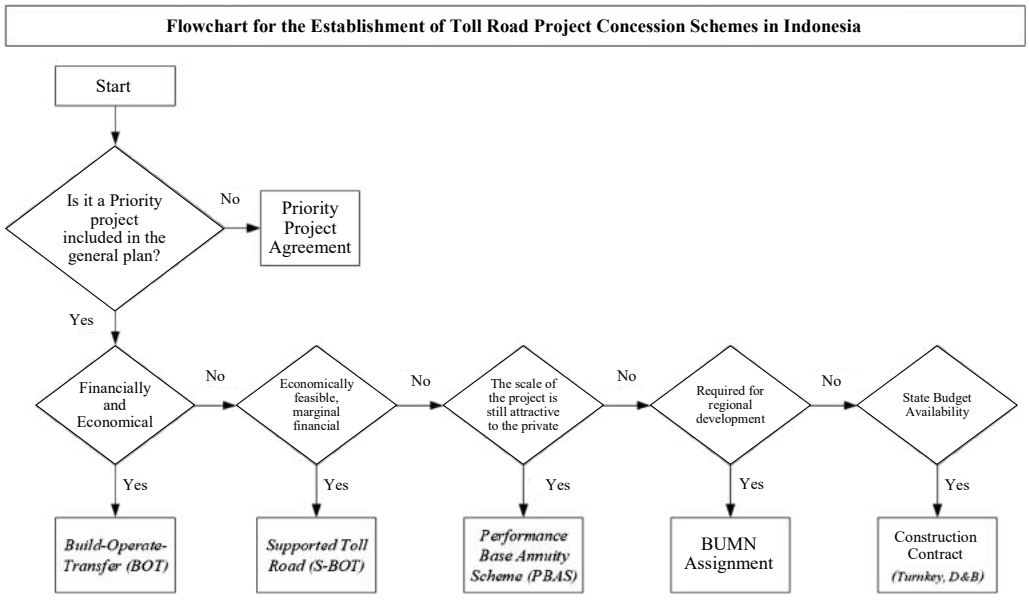

Figure 4. Flowchart for the establishment of toll road project concession schemes in Indonesia (BPJT, 2016)

Diterima 22 Juli 2019, Direvisi 13 Maret 2020, Diterima untuk dipublikasikan 14 April 2020

Performance Index (SPI) is used to measure project cost efficiency using the earn value concept. Payment Performance Index (BPI) is used to measure the efficiency of billing to the owner which will determine the cash flow owned by the contractor to work on the project, assuming the contract's payment method is lump sum. The OHS performance index (SFI) is used to measure the occupational health and safety performance with the time loss approach on the project. The Team Satisfaction Index (TSI) is used to measure the satisfaction of the project team, determined by an assessment from project team members involved in the areas of concern. Meanwhile, the Client Satisfaction Index (CSI) is used to measure the satisfaction of the client, determined by an assessment by the client on the contractor team for achievements in the areas of concern. From the performance index, there are 5 performance rating categories (A, B, C, D, and F), where the rating indicator for each category is: A for "awesome performance", B for "exceeding the target", C for "in the target" , D for "below target", and F for "poor performance".

In this study, the performance of toll road construction projects was measured by adopting the Nassar assessment system (2009). From the preliminary research, there were several performance indicators that could not be measured due to limited data access, so the performance indicators adopted in this study were the performance of schedule, payment, OHS, quality, client satisfaction, and project team satisfaction. Meanwhile, in this study, there was an Environmental Performance Index (EPI) which was assessed based on BUJT's environmental impact mitigation indicators.

2.3 Project management maturity

Project management maturity is an indicator of the extent to which a specific process is explicitly defined, managed, measured, controlled and its effectiveness, where the project management maturity shows the potential growth of capabilities, indicates the wealth of the organization process (project management), and shows the consistency of the implementation of project management in projects owned by an organization (Paulk, et al., 1993). Meanwhile, on its relationship with construction performance, PM Solution (2008) identified that the more mature an organization in its project management, the more likely it is to achieve its project objectives successfully. This shows the relationship of project management maturity which also illustrates the maturity of a BUJT in managing its toll road construction projects to the achieved performance of construction projects.

There are many models for measuring project management maturity. This study used the combined adoption of the Solution Maturity model and IMSI Project Management Assessment Model (Holmes & Walsh, 2005), where the PM Solution model has been widely used in general, and the IMSI model includes indicators that can be generally understood by project management practitioners. Maturity measurement was done by reviewing 9 management areas with 5 maturity levels to get the total value of project management maturity, as shown in **Figure 5**.

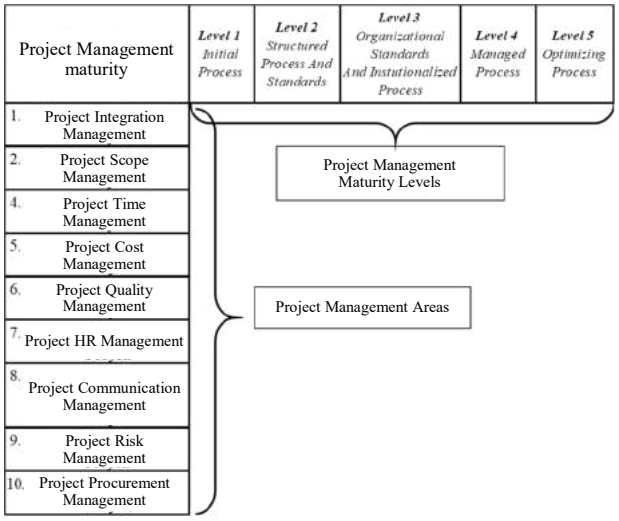

Figure 5. Project management maturity model
(Grant & Pennypacker, 2006)

2.4 Characteristics of toll road projects

Federal Highway Administration (*FHWA*) (2010) identified 5 characteristics of toll road projects that are important to note related identified 5 characteristics of toll road projects that need to be considered in relation to the operation of toll road infrastructure with PPP scheme, namely the project value, project complexity, strong public support, sources of income, and the environmental permit process. Meanwhile, Mahamid (2013) stated several factors that affect the cost deviation in the construction of sequential roads in terms of the level of influence, namely the project size (road length and width), the suitability of the soil and rocks of the project, the project soil condition, and the soil and rock constructability condition at the project site.

One strong public support indicator in the PPP scheme is the land acquisition process, which includes handling land acquisition funding (Lindsay, 2012). The toll road land acquisition scheme in Indonesia is regulated in Law no. 2 of 2012, where the land acquisition financing scheme is regulated in Finance Minister Regulation No.21/PMK.06/2017. In Finance Minister Regulation No.21/PMK.06/2017, There are 2 land acquisition schemes, namely the direct compensation scheme by the government, and the bailout scheme by BUJT. In the direct compensation scheme, there are constraints on the limitations of the government budget, while in the bailout scheme, there is a problem where BUJT must bear the difference in loan interest against the cost of fund from the government reimbursement, ranging from 4.5-5.5% (Nobel & Larasati, 2017).

In the construction phase, in addition to land acquisition funding, another thing to consider is contractor funding. Alfen, et al. (2009) conducted a study on innovation in project funding as one of the

Diterima 22 Juli 2019, Direvisi 13 Maret 2020, Diterima untuk dipublikasikan 14 April 2020

characteristics of a toll road project specifically in Indonesia, namely the Contractor's Pre-Financing (CFP) scheme. Contractor's Pre-Financing (CFP) is a project financing scheme that begins with an agreement between a business entity and a bank to guarantee a money loan so that with the agreement, the contractor can make a loan directly to the bank. The main difference between the Contractor's Pre-Financing funding scheme and the contractor funding scheme that is generally used or often called the investment credit is that the business entity is not directly involved in debt during the construction phase.

3. Research Methodology

From the results of the literature study, various types of variables that need to be considered in the construction phase of the toll road PPP scheme were identified, including the toll road PPP scheme concession variables (concession scheme, project delivery, BUJT-contractor corporate relations, land acquisition scheme), BUJT Project Management Maturity, and characteristics of toll road construction projects (project value, road length, contractor financial scheme). Of the many variables that need to be considered in relation to construction performance, an analysis to identify patterns was needed. Another obstacle in this research was the limited access to data that could be provided by BUJT, considering the many investment interests of the company that are confidential. With the obstacles of data limitations and the number of variables reviewed, a Qualitative Comparative Analysis was used to obtain the patterns of achievement of toll road construction project performance.

3.1 Qualitative comparative analysis

Qualitative comparative analysis (QCA) was first put forward by sociologist Charles Ragin in 1987. Qualitative comparative analysis is an analysis technique that combines quantitative and qualitative methods, shown in **Figure 6**, which originally focused on a small sample but its development has made it possible on a broader context (Ragin, 2014). QCA enables the identification of meaningful patterns even when very detailed and comprehensive case information is not available, or is often commercially sensitive and difficult to obtain (Gross & Garvin, 2011), where the advantages of this method are the basis used in this study, considering the PPP scheme concession's data is a piece of limited data information that is quite difficult to dig deeper. The QCA method has 3 types of sub-methods namely crisp set QCA (csQCA), fuzzy set QCA (fsQCA), and multi variable QCA (mvQCA). While the mvQCA sub-method, in its analysis, allows multi-value conditions which can accommodate different categories in 1 variable represented by natural numbers (0,1,2,3, etc.). In this study, the QCA sub-method used was the mvQCA sub-method, where this sub-method was the most suitable approach to the characteristics of the data in this study, which consisted of many variables with multiple variable variations.

3.1.1 Identification of outcome variables

From the results of the literature review, the construction project performance aspects identified for review of its achievements in this study consisted of 7 performance aspects, namely schedule, payment, OHS, quality, project team, client satisfaction, environment, and aspects of total performance which is an average of the seven the performance aspects reviewed.

3.1.2 Identification of condition variables

From the results of the literature review and several approaches in determining condition variables, 8 condition variables that affect the achievement of the PPP toll road construction project performance were identified. The condition variables identified are project delivery, concession scheme, toll road length, toll road construction costs, BUJT-contractor corporate relation, contractor financial scheme, land acquisition scheme, and project management maturity (9 management areas and total maturity).

3.1.3 Case study framework

QCA generally does not have a rigid limit on the amount of data, but it is recommended that the amount of data used in QCA analysis is in the intermediate range, which is from 5-50 data (Ragin, 2003). In this study, 14 BUJT case studies were identified that have met the recommended amount of data in the QCA analysis and have covered all toll road networks in BUJT toll road concessions in Indonesia (Trans Jawa, Trans Sumatra, Jabodetabek, and Non-Trans Jawa).

3.1.4 QCA table preparation

From the condition variables and the outcome variables, a QCA analysis model was prepared. The QCA model analyzes outcome variables and condition variables in the form of a numerical model. In this study, the numerical model of condition variables and outcome variables were prepared and shown in **Table 1**

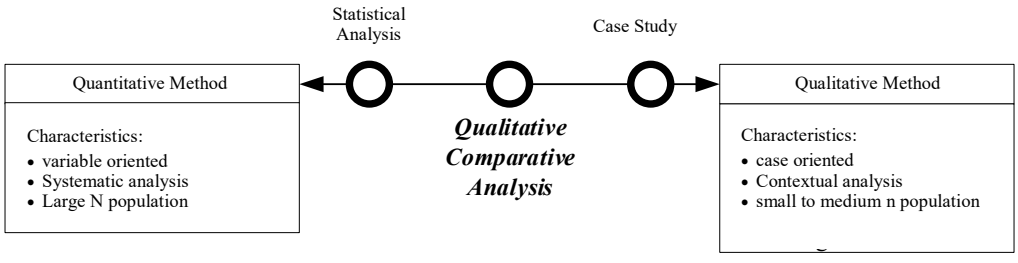

Figure 6. Qualitative comparative analysis (QCA) method spectrum

Diterima 22 Juli 2019, Direvisi 13 Maret 2020, Diterima untuk dipublikasikan 14 April 2020

dan **Figure 7**. Meanwhile, the QCA model in the form of a numeric configuration table, which in this study is presented in **Table 2**, is the result of a survey of 14 BUJT case studies on 14 toll road sections under the PPP scheme. In numerical modeling of construction project performance outcome variables, the modeling is based on existing rating category indicators (Nassar, 2009), where the rating categories A, B, and C that have "awesome performance" to "in the target" indicators are modeled as good performance outcome variables. While the D, and F rating categories that have "below target" and "poor performance" indicators are modeled as poor performance outcome variables.

4. Analysis Results and Interpretations

The analysis was done using the help of the Tosmana V1.6 software. Following are the results of QCA analysis on 7 performance aspects and total performance of construction projects.

4.1 Schedule performance index (SPI) results

The result of QCA analysis on the schedule performance is shown in **Table 3**. Schedule performance will be achieved either with the strongest pattern in a combination of BOT scheme condition with a construction cost of Rp 3.5 – 7 trillion, or a combination of 0 - 50km long toll road condition and BUJT project management maturity at level 4, or a combination of the construction cost of Rp3.5 – 7 trillion and the investment credit contractor's financial scheme, or a combination of the construction cost of Rp0 - 3.5 trillion and the BUJT project management maturity at level 4. The analysis showed that there was no difference in the D-B-B or D&B project delivery. The variables that affected the schedule performance index (SPI) were the concession scheme, toll road length, construction costs, contractor's financial scheme, and BUJT project management's level of maturity.

Table 1. Numerical models of condition variables and outcome variables

Condition/ Outcome	Variable Name	Category	Value
Project delivery scheme	PD	Design-Bid-Build	0
		Design&Build	1
Concession scheme	USAHA	BOT	0
		S-BOT	1
		SOE Assignment	2
Toll road length	LENGTH	0-25 km	0
		25-50 km	1
		>50 km	2
Construction costs	COST	0 - 3.5 trillion	0
		3.5 - 7 trillion	1
		> 7 trillion	2
BUJT-Contractor corporation relation	CORP	No corporate relation	0
		There is a corporate relation	1
Financial scheme	FINANCIAL	Investment credit	0
		Contractor pre-financing	1
Land acquisition scheme	LAND	Direct repayment by the government	0
		BUJT bailouts	1
Project management (general) and 9 Project management areas	MPM and INT, SCOPE, TIME, COST, QLTY, SDM, COM, RISK, PROC	Level 1 Maturity	1
		Level 2 Maturity	2
		Level 3 Maturity	3
		Level 4 Maturity	4
		Level 5 Maturity	5
Construction Project Performance	SPI, BPI, SFI, QPI, TSI, CSI, EPI, TOTAL	c	0
		Good performance (A,B,C criteria)	1

4.2 Payment performance (*BPI*) results

The result of QCA analysis on the payment performance is shown in **Table 2**. As for in general (for all project deliveries), payment performance will be achieved either under the condition of the SOE assignment and BOT concession scheme, or BUJT project management maturity at level 3, or the condition of the construction cost of Rp0 - 3.5 trillion and BUJT bailout land acquisition scheme. In the Design-Bid-Build project delivery, the payment performance (BPI) will be achieved well on the BUJT bailout land acquisition scheme. This is consistent with the results of the literature study, where the advantages of the BUJT bailout land acquisition scheme aim to accelerate the progress of the project so that it can be carried out properly. Meanwhile, in the Design&Build project delivery, the payment performance (BPI) will be well achieved in the investment credit contractor's financial scheme. This is consistent with the results of the literature study in which the investment credit financial scheme does not burden the contractor in terms of funding so that it can focus more on the project progress and the project progress payment can be properly implemented.

4.3 OHS performance (*SFI*) results

The result of QCA analysis on the OHS performance is shown in **Table 4**. Generally, in the Design-Bid-Build and Design&Build project delivery, OHS performance (SFI) will be achieved well under the condition of the BOT concession scheme and the construction cost of Rp 0 - 3.5 trillion, or on the condition of the construction cost of Rp 3.5 – 7 trillion, or the condition of the construction cost of Rp 0 -3.5 trillion and financial investment credit scheme, or the condition of construction cost higher than Rp7 trillion with project management maturity at level 3. Specifically, in the Design-Bid-Build project delivery, OHS performance (SFI) will be achieved well under the condition of the construction cost higher than Rp 7 trillion. The large number of performance patterns related to construction cost is consistent with the findings of previous studies that one of the main factors determining the application of OHS in Indonesia is the cost factor (Ong, Suryadharma, & Andi, 2018).

4.4 Quality performance index (QPI) results

The result of QCA analysis on the quality performance is shown in **Table 6**. K quality performance index (QPI) will be achieved well under the condition of the SOE assignment and BOT concession scheme, or the toll road length of 0 - 50 km, or the BUJT project management maturity at level 4. The findings of investment scheme factors determine the quality

Diterima 22 Juli 2019, Direvisi 13 Maret 2020, Diterima untuk dipublikasikan 14 April 2020

performance related to previous research, which found a strong relationship between construction quality and investment costs in the PPP scheme (Price water house Coopers Advisory S.p.A., 2014).

4.5 Team satisfaction index (TSI) results

The result of QCA analysis on the team project performance is shown in **Table 7**. Generally, in the Design-Bid-Build and Design&Build project delivery, the project team satisfaction index (TSI) will be achieved well in the strongest pattern with the condition of the construction cost of Rp3.5 - 7 trillion, or the condition of the toll road length of 0 - 50 km with BUJT project management maturity at level 3. In the Design-Bid-Build project delivery, the project team satisfaction index (TSI) will be well achieved in the condition of toll road length > 50 km. While in the Design&Build project delivery, the project team satisfaction index (TSI) will be achieved well under the condition of the construction cost of Rp 0 - 3.5 trillion with the BUJT bailout land acquisition scheme or a combination condition of the construction cost of Rp 0 - 3.5 trillion and the existence of a corporate relationship between BUJT and contractor. The pattern of construction performance variables related to construction costs that have high strength (coverage) is related to previous research where there are findings that the provision of incentives in construction projects can improve the performance of the project team, in this case, contractor productivity (Sarli & Adianto, 2017).

Table 2. QCA configuration table

ID	PD	WORK	LENGTH	COST	CORP	FINANCIAL	LAND	MPM	SPI	BPI	SFI	QPI	TSI	CSI	EPI	TOTAL
BUJT 1	1	0	0	0	0	0	0	4	1	1	1	1	0	0	1	1
BUJT 2	0	0	1	0	1	1	1	3	0	1	0	1	0	0	1	0
BUJT 3	1	2	0	0	1	0	1	4	1	1	1	1	1	1	1	1
BUJT 4	1	1	2	1	1	1	1	4	0	0	1	1	1	1	1	1
BUJT 5	1	2	2	2	1	0	1	4	0	1	0	1	0	1	0	0
BUJT 6	1	1	0	0	1	0	1	3	0	1	1	0	1	1	0	1
BUJT 7	0	0	2	1	1	0	1	3	1	1	1	1	1	1	0	1
BUJT 8	0	0	1	0	1	1	1	3	0	1	1	1	1	1	1	1
BUJT 9	0	0	1	2	1	0	1	3	0	1	1	1	0	0	1	1
BUJT 10	0	1	1	0	1	0	0	4	1	0	1	1	0	0	1	0
BUJT 11	0	0	2	2	1	1	1	3	0	1	1	1	1	1	1	1
BUJT 12	0	0	1	1	1	0	1	4	1	1	1	1	1	1	1	1
BUJT 13	0	0	1	2	1	0	1	3	0	1	1	1	1	1	1	1
BUJT 14	1	0	1	1	1	0	1	3	1	1	1	1	1	1	1	1

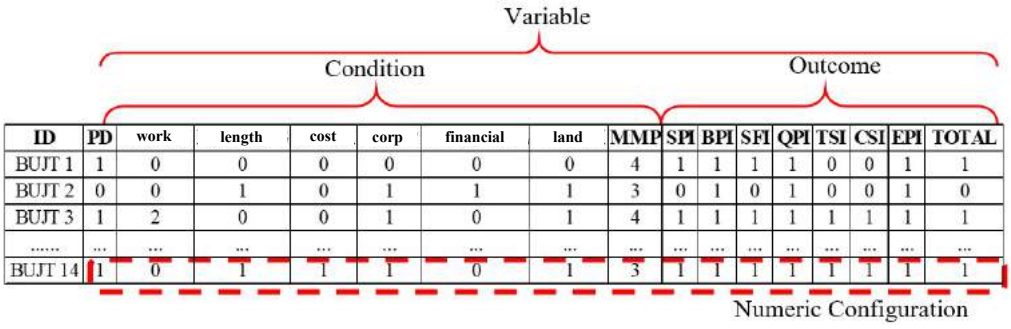

Figure 7. QCA configuration table model

Table 3. Schedule performance index (SPI) QCA analysis results

Parameter	Analysis Results				
QCA Expression	LENGTH{0,1}* MPM{4} +	WORK {0} * COST {1} +	COST{1}* FINANCIAL{0} +	COST{0}* MPM{4} +	COST{1}* MPM{3} +
Interpretation	Length of 0-50km and maturity at level 4	BOT concession scheme and cost of Rp. 3.5-7 T	Cost of Rp.3.5-7 T; and financial contractor's investment credit scheme	Cost of Rp.0-3.5 T; and maturity at level 4	Cost of Rp.3.5-7 T; and maturity at level 3
Case Study	(BUJT1+ BUJT3 + BUJT10 + BUJT12)	(BUJT 7+BUJT 12+BUJT 14)	(BUJT7 + BUJT12 + BUJT14)	(BUJT1 + BUJT3 + BUJT10)	(BUJT7 + BUJT 14)
Coverage	4/14= 28.57%	3/14= 21.43%	3/14= 21.43%	3/14= 21.43%	2/14= 14.29%

Diterima 22 Juli 2019, Direvisi 13 Maret 2020, Diterima untuk dipublikasikan 14 April 2020

Table 4. OHS Performance (SFI) QCA analysis results

Parameter	Analysis Results				
QCA Expression	PD{0} * COST{2}	COST{1} +	COST{0} *FINANCIAL{0} +	COST{2} * MPM{3} +	WORK{0} * COST{2} +
Interpretation	D-B-B Project delivery and cost > Rp. 7 T	cost of Rp.3.5-7 T	Cost of Rp.0-3.5 T and financial contractor's investment credit scheme	Cost > Rp.7 T and maturity at level 3	BOT concession scheme and cost of Rp.0-3.5T
Case Study	(BUJT 9,BUJT 13+BUJT 11)	(BUJT 4+BUJT 7+ BUJT 12+BUJT 14)	(BUJT 1+ BUJT 3+ BUJT 6+ BUJT 10)	(BUJT 9, BUJT 13+ BUJT 11)	(BUJT 9, BUJT 13+BUJT 11)
Coverage	3/14= 21.43%	4/14= 28.57%	4/14= 28.57%	3/14= 21.43%	3/14= 21.43%

Table 5. Quality performance index (QPI) QCA analysis results

Parameter	Analysis Results		
QCA Expression	WORK {0,2} +	LENGTH{1,2} +	MPM{4}
Interpretation	BOT concession scheme and SOE Assignment	Toll road length of >25km	MPM at level 4
Case Study	(BUJT 1+BUJT 2,BUJT 8 + BUJT 3+ BUJT 5+BUJT7+ BUJT 9,BUJT 13+BUJT11+ BUJT 12+BUJT 14)	(BUJT 2,BUJT 8+BUJT 4+BUJT 5+BUJT 7+BUJT 9, BUJT 13+BUJT 10+BUJT 11+BUJT 12+BUJT 14)	(BUJT 1+BUJT 3+BUJT 4+BUJT 5+BUJT 10+BUJT 12)
Coverage	11/14= 92.86%	11/14= 92.86%	6/14= 42.86%

Table 6. Payment performance index (BPI) QCA analysis results

Parameter	Analysis Results						
QCA Expression	PD{1} * FINANCIAL{0} +	PD{0} * LAND {1}+	FINANCIAL{0}* LAND{1} +	MPM {3} +	LENGTH {0} +	COST {0} * LAND {1} +	WORK {0,2}
Interpretation	Project delivery D&B and financial contractor's investment credit scheme	Project delivery D-B-B and bailout land acquisition scheme	Financial contractor's investment credit scheme and bailout land acquisition scheme	Maturity at level 3	Toll road length of 0 - 25 km	Construction cost of Rp0-3.5 T and bailout land acquisition scheme	BOT concession scheme and BUMN Assignment
Case Study	(BUJT 1+BUJT 3+BUJT 5+BUJT 6+BUJT 14)	(BUJT 2,BUJT 8+BUJT 7+BUJT 9,BUJT 13+BUJT 11+BUJT 12)	(BUJT 3+BUJT 5+BUJT 6+BUJT 7+BUJT 9,BUJT 13+BUJT 12+ BUJT 14)	(BUJT 2,BUJT 8+ BUJT 6+ BUJT 7+BUJT 9, BUJT 13 + BUJT 11 + BUJT 14)	(BUJT 1+BUJT 3+BUJT 6)	(BUJT 2,BUJT 8+BUJT 3+BUJT 6)	(BUJT 1+BUJT 2,BUJT 8+BUJT 3+BUJT 5+BUJT 7+BUJT 9,BUJT 13+BUJT 11+BUJT 12+BUJT 14)
Coverage	5/14= 35.71%	7/14= 50%	8/14= 57.14%	8/14= 57.14%	3/14= 21.43%	4/14= 28.57%	11/14= 78.57%

Table 7. Team satisfaction index (TSI) QCA analysis results

Parameter	Analysis Results						
QCA Expression	COST{1} +	LENGTH{0,2} * MPM{3} +	WORK {0,1} * LENGTH {2} +	LENGTH{2} * PD{0}+	COST{0}* LAND{1}* PD{1} +	PD{1}COST{0}* CORP{1} +	LENGTH{0}* CORP{1}
Interpretation	Cost of Rp.3.5-7 T	Length of 0-50 km; and maturity at level 3	BOT and S-BOT concession scheme and length >50km	Length of >50 km; and D-B-B Project delivery	Cost of RP.0-3.5T; and BUJT bailout land acquisition scheme; and D&B project delivery	Cost Rp. 0-3.5T; and BUJT-Contractor corporate relationship	Length of 0-25 km and BUJT-Contractor corporate relationship
Case Study	(BUJT 4+BUJT 7+BUJT 12+BUJT 14)	(BUJT 6+BUJT 7+BUJT 11)	(BUJT 3+BUJT 6)	BUJT 7+BUJT 11)	(BUJT 3+BUJT 6)	(BUJT 3+BUJT 6)	(BUJT 3+ BUJT 6)
Coverage	4/14= 28.57%	3/14= 21.43%	2/14= 14.29%	2/14= 14.29%	2/14= 14.29%	2/14= 14.29%	2/14= 14.29%

4.6 Client satisfaction index (CSI) results

The result of QCA analysis on the client satisfaction is shown in **Table 8**. Generally, in the Design-Bid-Build and Design&Build project delivery, client satisfaction index (CSI) will be achieved well under the condition of the toll road length > 50km, or the condition of the construction cost of Rp 3.5 - 7 trillion, or the condition of the BUJT bailout land acquisition scheme with project management maturity at level 4. Specifically, in the Design&Build project delivery, the client satisfaction index (CSI) can be achieved well on the BUJT bailout land acquisition scheme, or on a condition where there is a corporate relationship between BUJT and the contractor. The existence of a Design&Build project delivery variable pattern shows

Diterima 22 Juli 2019, Direvisi 13 Maret 2020, Diterima untuk dipublikasikan 14 April 2020

Table 8. Client satisfaction index (CSI) QCA analysis results

Parameter	Analysis Results				
QCA Expression	LENGTH{2}+	COST{1} +	LAND{1} * MPM{4} +	CORP{1}* PD{1}+	LAND{1}* PD{1}
Interpretation	Toll road length of >50km	Cost Rp.3.5-7 T	BUJT bailout land acquisition scheme and maturity at level 4	BUJT-Contractor corporate relationship and D&B project delivery	BUJT bailout land acquisition scheme and D&B project delivery
Case Study	(BUJT 4+BUJT 5+ BUJT 7+BUJT 11)	(BUJT 4+BUJT 7+ BUJT 12+BUJT 14)	(BUJT 3+BUJT 4+ BUJT 5+BUJT 12)	(BUJT 3+BUJT 4+BUJT 5+BUJT 6+BUJT 14)	(BUJT 3+BUJT 4+BUJT 5+BUJT 6+BUJT 14)
Coverage	4/14= 28.57%	4/14= 28.57%	4/14= 28.57%	5/14= 35.71%	5/14= 35.71%

Table 9. Environmental performance index (EPI) QCA analysis results

Parameter	Analysis Results				
QCA Expression	LENGTH{1} +	COST{0,1}*MPM{4}+	WORK{0}* COST{0,2}+	PD {0} * COST {0,2}+	PD{1} * COST{1}
Interpretation	Toll road length of 25-50km;	Construction cost of Rp.0-7 T and maturity at level 4	BOT concession scheme; and construction cost of Rp. 0-7T	Construction cost of Rp.0-7 T and D-B-B project delivery	D-B-B Project delivery and Construction cost of 0-3.5 T
Case Study	(BUJT 2, BUJT 8+BUJT 9,BUJT 13+BUJT 10+BUJT12+BUJT 14)	(BUJT 1+BUJT 3+BUJT 4+BUJT 10+BUJT 12)	(BUJT 1+BUJT 2,BUJT 8+BUJT 9,BUJT 13+ BUJT 11)	(BUJT 2,BUJT 8+BUJT 9,BUJT 13+BUJT 10+ BUJT 11)	(BUJT 4+BUJT 14)
Coverage	6/14= 42.86%	5/14= 35.71%	6/14= 42.86%	6/14= 42.86%	2/14= 14.29%

Table 10. Total project performance QCA analysis results

Parameter	Analysis Results				
QCA Expression	COST{1}+	WORK{0}* FINANCIAL{0}+	COST{2} * MPM{3} +	PD{0} * COST{2}+	PD{1}*COST{0}
Interpretation	Cost of 3.5-7 T	Cost of Rp.0-3.5T; and financial contractor's investment credit scheme	Cost of Rp.>7 T; and maturity at level 3	D&B Project delivery; and cost of Rp.>7T	D&B Project delivery; and cost of Rp.0-3.5T
Case Study	(BUJT 4+BUJT 7+ BUJT 12+BUJT 14)	(BUJT 1+BUJT 7+BUJT 9,BUJT 13+BUJT 12+ BUJT 14)	(BUJT 9,BUJT 13+ BUJT 11)	(BUJT 9,BUJT 13+ BUJT 11)	(BUJT 1+BUJT 3+ BUJT 6)
Coverage	4/14= 28.57%	6/14= 42.86%	3/14= 21.43%	3/14= 21.43%	3/14= 21.43%

a finding linear with the previous study where the Design&Build project delivery has more advantages in client satisfaction compared to design-bid-build on the road construction in reducing the duration of the project, capital costs, and establishing a better relationship between the parties involved (Koppinen & Lahdenperä, 2004).

4.7 Environmental performance index (EPI) results

The result of QCA analysis on the environmental performance is shown in **Table 9**. Generally, in the Design-Bid-Build and Design&Build project delivery, the environmental performance index (EPI) will be achieved well under the condition of the toll road length of 25 - 50 km or condition of the construction cost of Rp0 - 7 trillion with a combination of BUJT project management maturity at level 4, or the condition of BOT concession scheme with a combination of the construction costs of Rp 0 - 3.5 trillion and > Rp 7 trillion. In the Design-Bid-Build project delivery, the environmental performance index (EPI) will be achieved well under the condition of the construction cost of Rp 0 - 3.5 trillion and > Rp7 trillion. While in the Design&Build project delivery, the environmental performance index (EPI) will be achieved well under the condition of the construction cost of Rp 3.5 - 7 trillion. The pattern of construction costs as a variable that influences environmental performance is in line with previous research findings where one of the main obstacles in environmental management is the high cost (Chandra & Christian, 2002).

4.8 Total project performance results

The result of QCA analysis on the total project is shown in **Table 10**. Generally, in the Design-Bid-Build and Design&Build project delivery, the total project performance will be achieved either under the condition of the construction cost of Rp 3.5 - 7 trillion, or the condition of the BOT concession scheme with the condition of investment credit financial scheme, or the condition of the construction cost of Rp 7 trillion with BUJT project management maturity at level 3. In the Design-Bid-Build project delivery, the total project performance will be achieved well under the condition of construction cost > Rp 7 trillion. While in the Design&Build project delivery, the total project performance will be achieved well in the condition of the construction cost of Rp 0 - 3.5 trillion. From the pattern of the strongest variables, the BOT Scheme strongly influences project performance in accordance with the study of literature wherein economic feasibility, BOT provides adequate investment certainty

Diterima 22 Juli 2019, Direvisi 13 Maret 2020, Diterima untuk dipublikasikan 14 April 2020

to BUJT (BPJT, 2016). The investment credit contractor's financial scheme strongly influences project performance in accordance with the literature study in which the investment credit scheme provides concessions to the contractor, where the contractor is not financially charged, whereas, in the contractor pre-financing scheme, the contractor is also burdened with financial burdens during the toll road construction (Alfen, Ogunlana, Kalidindi, & Wang, 2009).

5. Discussion

Table 11 shows the summary of the strongest performance patterns in each performance aspect determined by the highest coverage value. From those achievement patterns, it appears that variations in project delivery do not have a strong influence on the construction project performance achievement in the aspects reviewed and the total project performance. In the aspects reviewed, the quality performance index (QPI) and payment performance index (BPI) have the strongest variable patterns in this study. The strongest variable patterns show that the BOT concession scheme and the SOE assignment concession scheme have a strong and relatively consistent role in the interaction of various variables to achieve quality and payment performance on the toll road PPP scheme project.

In **Table 12**, characteristic patterns of construction project performance achievements in each variation of project delivery are shown. From those characteristic patterns, Design&Build project delivery has an influence on more performance aspects, which is on 5 performance aspects with 7 characteristic patterns, more than the design-bid-build project delivery which has characteristic patterns on 5 performance aspects with 5 characteristic patterns. This shows the same indication as the study by Koppinen & Lahdenperä (2004) which shows that Design&Build project delivery gives a better influence on the construction project performance achievement compared to the conventional project delivery (design-bid-build).

From BUJT and the contractor's corporate relationship on the construction project performance achievement

Table 11. Performance achievement patterns of construction projects (strongest) in toll road PPP variables variations

Performance	Achievement Patterns	Coverage
Schedule (SPI)	Toll road length of 0-50km and project management maturity at level 4	28.57%
Payment (BPI)	BOT concession scheme; **or** SOE Assignment scheme	78.57%
OHS (SFI)	Construction cost of Rp.3.5-7 trillion; **or** construction cost of Rp.0-3.5 trillion and financial contractor's investment credit scheme	28.57%
Quality (QPI)	BOT concession scheme; **or** SOE assignment scheme; **or** toll road length of >25km	92.86%
Project Team (TSI)	Construction cost of Rp.3.5-7 trillion	28.57%
Client Satisfaction (CSI)	design&build project delivery and BUJT-contractor corporate relationship; **or** design&build project delivery and BUJT bailout land acquisition scheme	35.71 %
Environment (EPI)	Toll road length of 25-50km; **or** BOT concession scheme and construction cost of Rp.0-3.5 trillion; **or** design-bid-build project delivery and construction cost of Rp0-3.5 trillion, >Rp.7 trillion	42.86%
Total Project Performance	BOT concession scheme and financial contractor's investment credit scheme	42.86%

Table 12. Characteristic performance achievement patterns of project delivery variations

Performance	Design-Bid-Build	Design&Build
Schedule (SPI)	-	-
Payment (BPI)	D-B-B Project delivery and BUJT bailout land acquisition scheme	D&B Project delivery and financial contractor's investment credit scheme
OHS (SFI)	D-B-B Project delivery and construction cost of >Rp.7 Trillion	-
Quality (QPI)	-	-
Project Team (TSI)	D-B-B Project delivery and road length of >50km	D&B Project delivery and BUJT bailout land acquisition scheme D&B Project delivery and BUJT-contractor corporate relationship
Client Satisfaction (CSI)	-	D&B Project delivery and BUJT bailout land acquisition scheme D&B Project delivery and BUJT-contractor corporate relationship
Environment (EPI)	D-B-B Project delivery and construction cost of Rp.0-3.5 Trillion or >Rp.7 Trillion	D&B Project delivery and construction cost of Rp.3.5-7 Trillion
Total Project Performance	D-B-B Project delivery and construction cost of >Rp.7 Trillion	D&B Project delivery and construction cost of Rp.0-3.5 Trillion

Diterima 22 Juli 2019, Direvisi 13 Maret 2020, Diterima untuk dipublikasikan 14 April 2020

patterns in all aspects reviewed, it was identified that the existence of a corporate relationship between BUJT and the contractor provides better construction project performance outcomes compared to the absence of a construction performance relationship. Meanwhile, in the land acquisition scheme, the performance pattern of overall good performance aspects is the BUJT bailout scheme. Although the results of the literature study of the BUJT bailout scheme provide additional financial burden to BUJT, one of the initial objectives of the BUJT bailout scheme is to accelerate land acquisition which has a better impact on project performance, so that the interest expense of the bailout fund can be considered as an additional investment since the planning stage by BUJT.

From the performance achievements in all aspects, it can also be observed that the contractor's financial scheme with a good overall performance pattern is the investment credit scheme. In accordance with the results of the literature study, the investment credit scheme reduces the financial burden to the contractor, so that after reviewing performance aspects (schedule, payment, OHS, total project performance), it provides good performance achievement patterns.

6. Conclusions

- From the results of the analysis of variations in project delivery with a combination of variable conditions for toll road PPP and the level of maturity of the BUJT project management, it is identified that project delivery variations do not have a strong effect on the performance of toll road construction projects as indicated by the weak influence of the achievement characteristic patterns in each variation of project delivery.
- Construction project performance is more influenced by toll road PPP concession variables (concession scheme, project management maturity, construction cost, road length, contractor financial scheme, BUJT-contractor corporate relationship, and land acquisition scheme).

7. Acknowledgement

This study was strongly supported by the Toll Road Regulatory Agency and the Ministry of Public Works and Public Housing, which had allowed us to conduct surveys in the construction phase of several toll roads and interviews with the BUJT. Another party who was also very helpful was the Consultant of PT. Marga Graha Penta for giving us access to toll roads secondary data and BUJT related to this study.

8. References

A.S. Pillai, A. K. (2002). Performance measurement of R&D projects in a multiproject, concurrent engineering environment. *International Journalof Project, 20*, 165-177.

Alfen, H. W., Ogunlana, S., Kalidindi, S., & Wang, S. (2009). *Public-Private Partnership in infrastructure development: Case studies from Asia and Europe.* Weimar: Bauhaus-Universität Weimar.

BPJT. (2007). *Sejarah Jalan Tol*. Dipetik Februari 25, 2019, dari http://bpjt.pu.go.id/konten/jalan-tol/sejarah

BPJT. (2016). *Peluang Investasi Jalan Tol di Indonesia.* Jakarta: BPJT.

BPJT. (2018). *Monitoring Progres Konstruksi Jalan Tol Indonesia.* Jakarta: BPJT.

BPJT. (2018). *Rencana Pembangunan Jalan Tol Trans Sumatera.* Padang: BPJT.

Chandra, H. & Christian, D., 2002. Analisa Sistem Manajemen Lingkungan (ISO 14000) dan Kemungkinan Implementasinya oleh Para Kontraktor Kelas A di Surabaya. *Dimensi Teknik Sipil,* 4(2), pp. 77-84.

Chrissis, M. B., Konrad, M., & Shrum, S. (2003). *CMII: Guidelines for process integration and product improvement.* Addison Wesley.

DetikFinance. (2019). *Belum Sebulan, Ruas-ruas Tol Ini Rusak*. Dipetik Maret 1, 2019, dari https://finance.detik.com/infrastruktur/d-4392361/belum-sebulan-ruas-ruas-tol-ini-rusak

Federal Highway Administration. (2010). *Public–Private Partnership Concessions for Highway Projects: A Primer.* Washington: Federal Highway Administration-U.S. Department of Transportation.

Grant, K. P. & Pennypacker, J. S., 2006. Project Management Maturity: An Assessment Project Management Capabilities Among and Between Selected Industries. *IEEE Transactions on Engineering Management,* 53(1), pp. 59-68.

Gross, M., & Garvin, M. (2011). Structuring PPP toll-road contracts to achieve public. *The Engineering Project Organization Journal pricing objectives, 1*, 143-156.

Holmes, S.J. & Walsh, R.T.(2005).Conducting Effective Project Management Maturity Assessment Interviews. *IMSI Tech.*

Haesebrouck, T. (2016). The Added Value of Multi-Value Qualitative Comparative Analysis. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research , 17*(1).

Kontan. (2016). *Ini tiga isu sensitif di proyek jalan tol*. Dipetik Februari 20, 2019, dari https://nasional.kontan.co.id/news/ini-tiga-isu-sensitif-di-proyek-jalan-tol

Koppinen, T., & Lahdenperä, P. (2004). *Road sector experiences on project delivery methods.* Finland: VTT Tiedotteita – Research Notes 2260.

Diterima 22 Juli 2019, Direvisi 13 Maret 2020, Diterima untuk dipublikasikan 14 April 2020

Lindsay, J. M. (2012). Compulsory Acquisition of Land and Compensation in Infrastructure Projects. *PPP Insights, 1*(3), 1-10.

Martinus P. Abednego, S. O. (2006). 'Good pro- ject governance for proper risk allocation in public-private partnerships in Indonesia'. *International Journal of Project Management, 24*, 622-634.

Milyardi, R. (2019). *[TESIS] Analisis Pengaruh Project Delivery Terhadap Kinerja Proyek Konstruksi Pada Pengusahaan Jalan Tol oleh Badan Usaha.* Bandung: Institut Teknologi Bandung.

Nassar, N. K. (2009). An integrated framework for evaluation of performance of construction projects. Orlando: Project Management Institute.

Nobel, A., & Larasati, N. (2017). Inovasi Pembiayaan Tanah untuk Proyek Jalan Tol yang Termasuk Dalam Proyek Strategis Nasional dengan Mempergunakan Mekanisme Dana Talangan. *Jurnal HPJI, 3*(2), 139-148.

Ong, J., Suryadharma, S. & Andi, A., 2018. Faktor-Faktor Penghambat Kontraktor Untuk Melaksanakan K3 Pada Proyek Konstruksi. *Jurnal Dimensi Pratama Teknik Sipil,* 7(1), pp. 173-180.

Price water house Coopers Advisory S.p.A. (2014). *Evaluation and future of road toll concessions* . ASECAP. Solutions.

Sarli, A. & Adianto, Y., 2017. Kajian Pemberian Insentif dalam Proyek Konstruksi dari Persepsi Pengguna Jasa dan Penyesia Jasa. *Jurnal ilmiah Teknik Sipil,* 21(1), pp. 24-33.

Takim, R., & Akintoye, A. (2002). Performance indicators for successful construction project. Greenwood: University of Northumbria.

Tempo. (2017). *Pembangunan Jalan Tol 2017 Tak Sesuai Target, Ini Penjelasan PU*. Dipetik Februari 25, 2019, dari https://bisnis.tempo.co/read/1036823/pembangunan-jalan-tol-2017-tak-sesuai-target-ini-penjelasan-pu

Tirto. (2018). *Daftar Kecelakaan Proyek Infrastruktur pada Awal 2018*. Dipetik Februari 20, 2019, dari https://tirto.id/daftar-kecelakaan-proyek-infrastruktur-pada-awal-2018-cE4M

Verweij, S. (2014). *A Short Introduction To Qualitative Comparative Analysis.* Rotterdam: Erasmus University Rotterdam.

World Bank. (2000). *Privatization and Regulation of Transport.* Washington: World Bank Institute.

Yimam, A. H. (2011). *Project Management Maturity In The Construction Industry of Developing Countries (The Case of Ethiopian Contractors).* College Park: Faculty of the Graduate School of the University of Maryland

Diterima 22 Juli 2019, Direvisi 13 Maret 2020, Diterima untuk dipublikasikan 14 April 2020