Jointly held with

ConCERN 2014

Conference for
Civil Engineering
Research Networks 2014

ACEC

7th ASEAN
Civil Engineering Conference
Under AUN/SEED-Net

Delivering Sustainable Infrastructure
Through Collaborative Research in Civil Engineering

4- 5 November 2014,
ITB Campus, Bandung, INDONESIA

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ConCERN 2014 Introduction

Civil engineering has been considered as one of prominent professions in creating a sustainable world and enhancing the global quality of life. Civil engineers' roles as planners, designers, constructors, and operators of the built environment have been taken for granted by the society, but nowadays, they are also challenged to become the stewards of the natural environment and its resources - sustainable infrastructure is not a jargon, it is a real need for the global society. It is believed that these challenges would only be answered by embracing the roles of civil engineers as innovators and integrators of ideas and technology across the public, private, and academic sectors. Hence, the civil engineering profession can offer the solutions to the society and the environment by taking major part in the infrastructure development process, becoming more aware of social, health, environmental and economic issues.

Innovations in civil engineering and integration among the stakeholders of the infrastructure development could not be possibly done by a party. Global needs and problems faced by the society become comparable, even though some would still be specific for some local conditions, and the specialization as a way of survival in this ever competitive environment called for collaborations in research and development among centers of excellence in the discipline of civil engineering. Despite the fact that collaboration has been an integral part of researching civil engineering for a long time, the nature of collaboration seems to be growing from one of conducting research within a center of excellence to newer areas necessitating partnerships across centers of excellence (e.g. academic, government, private industry).

Having considered the previous established networks of collaboration in civil engineering, the contemporary challenges requires more great deals of collaboration among scholars and practitioners in many centers of excellence. A conference that could cater the dissemination of collaboration results, the establishment of new collaboration, and the augmentation of the established collaborations is one of the immediate agenda to be implemented. Along that line of thought, the Faculty of Civil and Environmental Engineering (FCEE), Institut Teknologi Bandung, Indonesia, initiate an international conference called 'Conference for Civil Engineering Research Networks' or ConCERN in 2014. For the first time, this conference would instigate the thought of collaborations through the research networks in the area of civil engineering that the FCEE have already recognized. Hopefully, the conference would generate more establishments of national, regional, and international collaborations for the FCEE, and for the conference participants as well.

7th ACEC Introduction

The ASEAN Civil Engineering Conference (ACEC) under AUN/SEED-Net is a platform to share the most updated technology and research on common regional issues in order to contribute to the ASEAN community and to draw support from the industrial and the governmental sectors. The regional conference allows opportunities for AUN/SEED-Net members to publicise their research work, exchange ideas and discuss future collaborations and activities related to the civil engineering field. The conference itself is not only to enhance the academic network among the ASEAN universities but also to strengthen the relationship between ASEAN and Japanese professors of each university.

This year, the 7th ASEAN Civil Engineering Conference (ACEC) will be organised with the theme "Delivering Sustainable Infrastructure through Collaborative Research in Civil Engineering" at ITB Campus, Indonesia on 4 - 5 November 2014, held jointly with ConCERN 2014.

Objectives & Sub-themes

The ConCERN 2014, as reflected from its abbreviation, has the following objectives:

- To provide a platform for educators, scholars, practitioners, governments, and companies in construction industry to meet and exchange ideas;
- To provide an environment to disseminate research findings and innovations in the area of civil engineering as a result of collaboration and networks; and
- To fortify and expand collaborations in the civil engineering research networks.

The selected papers to be discussed in this conference would cover research ideas, findings, and innovations in the following sub-themes:

- **Structural Engineering and Materials**
- **Geotechnical Engineering**
- **Transportation Engineering and Planning**
- **Water Resources Engineering and Management**
- **Construction Engineering and Management**
- **Infrastructure Engineering and Management**

Programs

Day 1: Tuesday, 4 November 2014
Time: Morning
- **Opening Ceremony** (Plenary) & **Guest Speakers** (Plenary)

Time: Afternoon
- **Technical Paper Presentations** (Parallel)

Time: Evening
- **Cultural Dinner** (Plenary)

Day 2: Wednesday, 5 November 2014
Time: Morning
- **AUN/SEED-Net Field Management Meeting, Technical Paper Presentations** (Parallel), & **Closing Ceremony** (Plenary)

Time: Afternoon
- **Research Collaboration and Networks Meetings** (Parallel)
- **Side Events**

Keynote Speakers

- **Prof. George Ofori:** Ethics and Personal Responsibility in the Construction Industry, National University of Singapore, Singapore
- **Prof. Susumu Iai:** Combined Geotechnical Hazards Due to Tsunami and Earthquakes, Kyoto University, Japan.
- **Prof. Akimasa Fujiwara:** Analyzing Air Quality Based on Limited Monitoring Data in Developing City, Hiroshima University, Japan.
- **Prof. Kazuhiko Kasai:** Paper title to be announced, Tokyo Institute of Technology, Japan.
- **Prof. Kusuma., et al.:** Paper title to be announced, Water Resources Research Group, Institut Teknologi Bandung, Indonesia.

Invited Speakers

- **Djayanta Ginting:** Concrete That Contribute to Sustainable Construction, Value Added Solution Manager of Holcim Indonesia
- **Muh. Najib Fauzan:** Paper title to be announced, Director of Human Resources and General Affairs, Indonesian Highways Corp.
- **Nobuo Masaki, Dr.Eng.:** Computing Algorithm of Hysteresis Model of Deformation-History for Isolator, Bridgestone Corporation, Japan.

Place & Date

4- 5 November 2014

ITB Campus
Bandung, INDONESIA

Participants

The participants of the conference are expected to be civil engineering's scholars, government officers, designers, contractors, consultants, lecturers, students, and suppliers. The total attendant is expected to be around 200 people, coming from countries in the Asia Pacific region.

Papers Presented

We have reviewed and accepted 132 abstracts from Hong Kong, Philippines, Thailand, Vietnam, Japan, Bangladesh, Malaysia, Singapore, Taiwan, Korea, Norway, New Zealand, Myanmar, and Indonesia.

Important Dates (in 2014)

- Deadline of full paper submission: **15 Sep**
- Full paper acceptance notification: **29 Sep**
- Deadline of registration: **18 Oct**
- Deadline of revised full paper submission: **20 Oct**
- Conference for Civil Engineering Research Network (ConCERN 2014): **4-5 Nov**

ConCERN 2014 Secretariat

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Registration

Please fill in the registration form at:
http://concern.itb.ac.id/registration.html

The registration will be closed on **18 October 2014.**

Category
- International participant: **USD 200**
- International student participant: **USD 150**
- Local participant: **IDR 1.500.000**
- Local student participant: **IDR 1.000.000**

Limited numbers of financial supports are available based on proposal to the Organizing Committee.

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Getting to Bandung

For International participants, to get to the city of Bandung, you may use the Soekarno-Hatta International Airport (SHIA), at Cengkareng, near Jakarta (capital city of Indonesia, about 150 km from Bandung), or the Husein Sastranegara International Airport (Husein) at Bandung. The SHIA is serving major airlines from all around the world. From Jakarta, you can take a train, shuttle buses or travel mini buses to get to Bandung. However, the Husein airport is serving limited number of airlines, and only from Singapore and Kualalumpur, Malaysia.

If you need more information on how to get to Bandung from the SHIA, Jakarta, please visit this site:
http://www.international.itb.ac.id/web/?page_id=67

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Drivers for Increased Benefits in Performance-Based Contracts of Road Projects

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Abstract— **The use of performance-based contracting (PBC) on roads has gained popularity world-wide. In theory, because of the long-term relationship between an owner and a contractor, the implementation of this method will provide additional benefits for the government/public. Private sector involvement in financing public infrastructure through the use of PBC on roads should be scrutinized by policy makers regarding its benefits. The use of PBC on Indonesian roads have just recently been introduced via two pilot projects initiated by the Directorate General of Bina Marga, Ministry of Public Works. While policy makers have been considering to expand the use of PBC roads nationally, a study to explore the value-for-money drivers in those pilot projects was proposed. The review must also include the identification of the driving factors to achieve higher benefits and/or lower costs. Literatures suggest that there are twenty drivers for the PBC on roads. Respondents included nine personnel directly involved in the projects, representing owners and contractors. Structured interviews were conducted to identify the project specific drivers and the importance of each driver. Interviews were performed during a period in 2012-2013, which coincided with the two-year milestone after the four-year contract was initiated. The study found two additional drivers/factors as specific findings for these cases. It was also concluded that there were four essential factors/drivers as a basic requirements, i.e., "implementation of output specification," "clear and measurable definition of outcomes," "assurance of budget availability," and "performance specification implementation." Another major factor is effective promotion and support regarding the assurance of value-for-money of the use of PBC on roads, so that all parties will alter the work practices as imposed to the successful implementation of PBC.**

Keywords— performance-based, contract, drivers, benefits, road, infrastructure

I. Introduction

Construction delivery of national roads currently is still being hampered by a number of obstacles. The institution in charge of national roads, in particular the Directorate Bina Marga – Ministry of Public Works, has tried to find a number of solutions, one in particular is through the use of an alternative construction contract. Road construction contract type which is regarded as a suitable alternative to a traditional type of contract is the "Performance-Based Contract" or from this point forward abbreviated as PBC. PBC is a type of a contract focused on the "performance" of a contractor's work rather than on the inputs/costs to perform the work. Advantages of PBC may logically be understood, however the justification of PBC implementation needs to be quantitatively elaborated further. A more widely use of PBC in the construction and/or maintenance of national road needs to be justified with the value-for-money, which are conducted through extensive evaluation of the costs and the benefits (whether there are any increase in benefits and/or reduction in costs) associated with the delivery scheme of infrastructure projects contracted to the private sector. A sound understanding of what drives the stakeholders for the successful use of PBC is also beneficial. The drivers for increase in benefits and/or reduction in costs for the road's life-cycle in the context of PBC will be identified. The following narrative will identify these drivers which will be the initial stage in order to provide quantitative evaluation scheme of PBC's effective implementation in the management of national roads by the government.

II. PBC Overview - Potential for Increase Benefits

A particular decision in contract types may influence the quality of works. The use of PBC has recently become a trend for road maintenance contracting method, due to the World Bank recommendations for starting pilot projects in several developing countries in Africa and Asia, including Indonesia. Based on positive experiences from other countries which have implemented PBC for road maintenance, the Ministry of Public Works should seriously review in details regarding its possible implementation in Indonesia. PBC implementation by the Ministry of Public Works has the potential to increase the level of service and reduce the costs associated with road maintenance. In PBC, the payment for the contractor is based on the outcome or "performance" of works achieved. Performance is calculated based on several level of services defined through road users perspective, which may include but not limited to, vehicle velocity, rider comfort, and safety. PBC puts pressures on the contractor to work more efficiently if they want to optimize their profit, with monthly payment may be reduced or even deferred if minimum "performance" is not achieved. With contractor's initiative in setting out their own work methods, an increase in the efficiency of public funds

usage is to be expected and also to encourage technological innovation in the construction industry.

III. Need For Evaluation Scheme and Drivers Identification

The typical challenge for PBC implementation, based on the experiences of countries which have implemented it, is the lack of support from the government and the legislative. PBC requires a paradigm shift in the management of national road infrastructure which entails long-term considerations and commitments. PBC is not suitable for a road maintenance project which is already in severe condition; if the time frame is too short; or a small contract value. In these cases, potential contractors show lack of interest which may make the bidding process not optimal. A more extensive implementation of PBC shall in the long run impose necessary changes to the organizational structure of the government road institution.

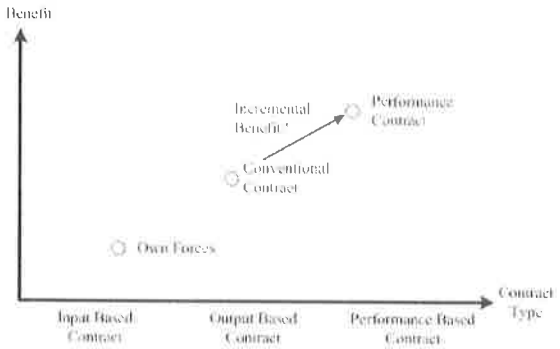

Fig 1. Increased Benefits with Different Contract Types (adapted from Hardy, 2001)

To gain strong support from stakeholders, a quantitative evaluation scheme justifying the value-for- money is required. The scheme would entail an in-depth understanding of the drivers/factors to achieve higher benefits and/or cost reduction during road's life-cycle in the context of PBC. As illustrated in Figure 1, the government should be able to objectively justify to the public that the implementation of PBC does provide more benefits and/or cost reduction (or "value-for-money"). When the public are convinced, then strong support will be given by the legislative; this way, PBC implementation can be understood and objectively acceptable to all stakeholders as a more efficient and effective type of contract to support national road construction/maintenance.

IV. Drivers Identification

Drivers for increased benefits in the context of partial hand over of infrastructure construction/maintenance obligation from the public/government to the private sector (such as public-private partnerships) generally encompass several points such as (Infrastructure Australia 2008):

1) Large project's scope and duration
2) Complex risks and possibility to divert said risks to private sector objectively
3) Evaluation of project's feasibility study which based on long-term consideration including life-cycle costing. Then its construction is integratedly contracted from planning stage to operational/maintenance stage.
4) Possibility for potential contractors to innovate on technical and cost aspects.
5) A more efficient use of assets by the private sector compared to the public sector.
6) Resource efficiency due to better integration between planning, construction, and operational and maintenance stages.
7) Better competition between potential contractors, which in the long-term will improve the quality of industry-wide construction sector.

A. Methodology

PBC implementation may be seen as a form of partial hand over of national road management obligation from the government to the private sector. The identified drivers/factors in the literatures are mostly relevant to PBC Indonesian context, however, the specific issues will be confirmed on PBC pilot project cases in Indonesia (e.g., road improvement project on Ciasem-Pamanukan route with a length of 18.5 km in the northern coast of West Java and road improvement project on Demak-Trengguli route with a length of 7.68 km also in the northern coast of Central Java). This study was conducted through surveys/interviews using structured questionnaires with stakeholders directly involved in the projects. Respondents included representatives from the Directorate General Bina Marga-Ministry of Public Works and the contractors. These interviews resulted in a list of driving factors as seen from both sides, the owners and the contractors. Analysis and discussion on the identified driving factors will then be conducted with a descriptive analysis method.

B. Drivers for Increased Benefits in PBC - literature study

Several literatures (H. M. Treasury, 1997; DPW-Queensland Government, 2000; Hardy, 2001; Segal et al., 2003; Carpenter et al., 2003; Zietlow, 2004; Berkland and Bell South, 2007; Kadar et al., 2008; Hyman, 2009; Michigan Department of Transportation, 2010) have identified twenty driving factors for the achievement of higher benefits in PBC implementation on road /infrastructure construction/ maintenance. Those driving factors are:

F1 "Risks transferred to contractors." Numerous risks that usually held by the government on a traditional contract are transferred to the contractor's side.
F2 "Long-term contract." Contract duration of much longer period is preferable; also in the form of a multi-years contract.
F3 "Large contract value." A substantially large contract value which attract more potentially qualified contractors to participate.
F4 "Contractors competition." With substantial duration and contract value, it may increase competitions among

potential contractors during the procurement process so the best contractors may be procured.

F5 "Contractor's capability." Technical and managerial skills of contractors to execute the contracted works.

F6 "Contractors selection based on best value evaluation." Selection of contractor is based on proportional technical and financial capabilities evaluation to procure the best contractor to execute the project.

F7 "Evaluation of contractors performance on prior projects." Evaluation of contractors performance on prior road projects to select contractor with good performance in executing said projects.

F8 "Contractors innovation." Contractor's capability to develop and use better technologies on all aspects of the project, including design, material, construction methods, and road maintenance.

F9 "Output specification implementation." Good rules regarding scope and quantity of the works and performance indicators for each specific activity contained within the PBC contract.

F10 "Performance measurement of the contractors." A detailed measurement rules on the fulfillment as stated in the performance indicators which may be achieved by the contractors.

F11 "Clear and measurable outcome implementation." Outcome selection in the form of suitable performance indicators (clear scale, measurable, and specific/relevant regarding road level of service).

F12 "Implementation of incentive and penalty mechanism." Mechanism on bonus award based on work results exceeding a certain performance level, and also a penalty/fine mechanism on inadequate work results below the threshold performance level.

F13 "Minimizing processes with impacts on costs/resources." Implementing work process, technology, design, and management, orientating on cost efficiency improvement including work productivity.

F14 "Adaptation of change procedure supervision." Monitoring and evaluation of contractor's performance done through a proper quality control procedure by the contractors internally and quality assurance by the owners.

F15 "Contractors involvement during design process." Contractor plays a role and gives advice during design process, in order to increase constructability and post construction (maintenance periods) responsibility fulfillment by the contractors.

F16 "Lump-sum payment system to contractors." Amount of payment to contractors is guaranteed, in time period and amount, which spurs the contractors to increase their efficiency and effectiveness in executing the project.

F17 "Partnership between owners and contractors." Better and stronger coordination and cooperation between owners and contractors to realize better road service performance.

F18 "Partnerships between contractors in the contract." Better and stronger coordination and cooperation between designers, contractors, sub-contractors, and construction supervisory firms to achieve better road service performance together.

F19 "Guaranteed budget availability." Budget availability is guaranteed to execute road construction/maintenance projects occurring in multi-years.

F20 "Availability of robust road condition data." Availability of existing road condition data which forms a base to set out type of road maintenance and proper performance indicators, and also realistic costs estimate for road projects.

These twenty factors have been identified through literature study which were then consulted and confirmed by PBC's practitioners in Ciasem-Pamanukan and Demak-Trengguli projects. Since PBC recently has gained the government's attention; these two pilot projects were evaluated to identify specific driving factors based on the point of views of the field/directly involved personnel.

C. Drivers on PBC of Road Construction Project Ciasem-Pamanukan and Demak-Trengguli

As PBC has gained only recent recognition by Indonesian stakeholders, the pilot projects experienced several challenges. Both parties representing the owner (Directorate General Bina Marga) and the contractor (joint operation between a design firm and a construction company) were not quite confident regarding PBC's potentials compared to traditional contract. Interviews were conducted in late 2012 to early 2013, at the time when it was more than two years since the start of the contract with a multi-year contact duration of four years. Activities in the first two-years of the contract mainly involved with developing of DED and road improvement construction, while the third and fourth years consisted of maintenance works. In effect, the stakeholders point of views and opinions were corresponding to the learning process.

Respondents representing the point of view of the owner included six personnel (i.e., PPK, Bintek staff, and supervisor representing Bina Marga in Ciasem-Pamanukan project and one respondent of PPK from Demak-Trengguli Project). The number of respondents for Ciasem-Pamukan Project representing the owners were many (R1 to R6) because the surveys/interviews were conducted at the time coincided with the event of monitoring and evaluation phase conducted by the Directorate General of Bina Marga (monev site visit). Respondents representing the contractor's point of view were both the project managers. The drivers/factors for achieving higher benefits in PBC of roads, based on respondents' opinions are summarized in Table 1.

Table 1. Drivers on Ciasem-Pamanukan and Demak-Trengguli Project

Drivers	Owner's Evaluation							Contractor's Evaluation	
	Ciasem-Pamanukan Project						Demak-Trengguli Project	Ciasem-Pamanukan Project	Demak-Trengguli Project
	R1	R2	R3	R4	R5	R6	R8	R7	R9
F1	√	√	√	√	√	√	√	√	√
F2		√	√	√	√	√	√	√	√
F3	√	√	√	√	√	√	√	√	√
F4	√	√	√	√	√	√	√	√	√
F5	√	√	√	√	√	√	√	√	√
F6		√	√	√	√	√	√	√	√
F7		√		√	√	√	√	√	√
F8	√	√		√	√	√	√	√	√
F9	√	√	√	√	√	√	√	√	√
F10	√	√	√	√	√	√	√	√	√
F11	√	√	√	√	√	√	√	√	√
F12		√	√	√	√		√	√	√
F13		√		√	√	√	√	√	√
F14	√	√	√	√	√	√	√	√	√
F15	√	√	√	√	√	√	√	√	√
F16	√	√	√	√	√	√	√	√	
F17	√	√	√	√	√	√	√	√	√
F18	√	√	√	√	√	√	√	√	√
F19	√	√	√	√	√	√	√	√	√
F20	√	√	√	√	√		√	√	√
F21**	√	√	√	√	√	√	√	√	√
F22**	√	√	√	√	√	√	√	√	√

Notes: **2 new drivers: F21 "Performance specification implementation" and F22 "Stakeholders knowledge on PBC."

As shown in Table 1, all twenty driving factors based on the literatures are relevant in the context of PBC implementation in Indonesia (in the cases of pilot projects). Numerous factors associated with risks transfer, contract strategy, selection system and capabilities of potential contractors, works orientation, partnership, budget guarantee, and availability of robust road condition data, are considered as drivers to achieve value-for-money according to the owners perspective. Owners also agree that PBC implementation has significant potential to achieve increased benefits for the government/public. Another interesting finding from the interviews is that there are two additional drivers specific in the context of the case studies, i.e., F21 "Implementation of performance specification", and F22 "Stakeholders knowledge on PBC."

F21 "Implementation of performace specification"

On the two pilot project cases, both owners agreed that the implementation of performance specification in a PBC is a significant driver to achieve increased benefits and/or costs reduction. Owners experienced changes in work practices of contractors which focused more on the fulfillment of agreed upon performance standards. The owners also convinced that efficiency on road maintenance budget will be acquired. Project management realized the trend on improved quality of work which will be sustainable in the long run.

F22 "Stakeholders knowledge on PBC"

Since owners did not yet fully realize the rules associated with PBC, this had become a barrier to all parties involved in PBC project. An example of this lack of knowledge was the issue of technical supervision in the field. On Ciasem-Pamankan and Demak-Trengguli projects, the traditional practices of construction supervision were still executed; a "consultant" firm was hired by the owner. Meanwhile, in PBC it is stated that contractors should form an internal quality control unit; thus the owner only conduct activities associated with quality assurance. The contractors should be able to exercise their autonomy in executing high quality of works which would have an impact upon cost efficiency of the contractors themselves. This can be achieved only with the better knowledge of PBC's day-to-day rules on interactions on sites.

The difference of the level of understanding of PBC rules on the two cases was indicated. On the Demak – Trengguli project, the parties were more open to learn and eventually implemented the new contract scheme better. Meanwhile, on the Ciasem – Pamanukan project, they were less convinced by PBC and more reluctant to exercise the new rules of contract.

Another note was the fact that the contract value of Demak – Trengguli project was higher with also higher unit cost of construction/maintenance of roads.

V. LEVEL OF IMPORTANCE OF VARIOUS DRIVERS

Twenty two drivers have been discussed in Section 4. However, the level of importance of these driver varies. Next,

the study followed with asking the respondents to rate them based on potential effectiveness implementation to achieve increased benefits in PBC. To ascertain level of importance or score for each driver/factor, in the specific context of Ciasem – Pamanukan and Demak – Trengguli pilot projects, respondents from both sides were asked to evaluate qualitatively/subjectively if each driver could be implemented effectively in three levels, namely "low", "medium", and "high." Summary of the responses are shown in Figure 2.

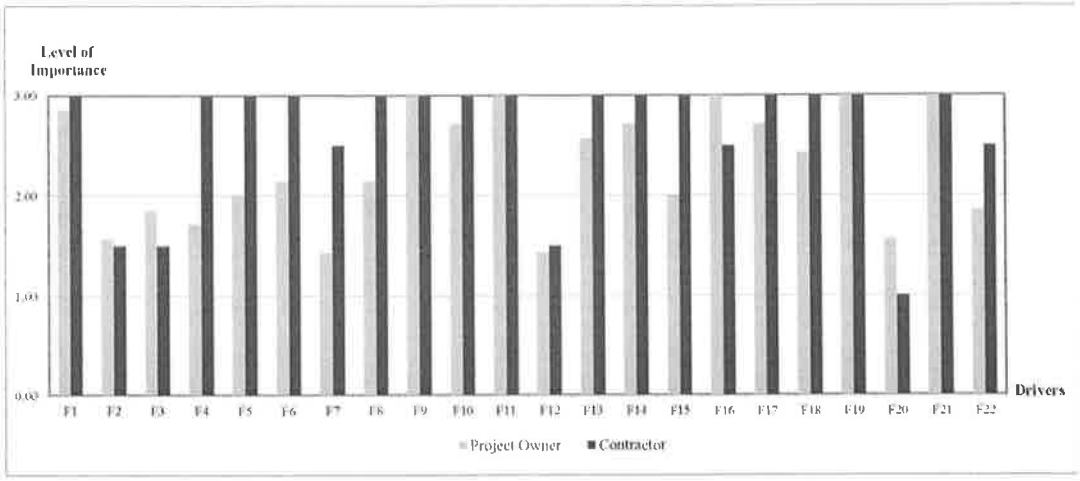

Figure 2. Drivers - level of importance evaluation

According to owners' perspective, there are five very important driving factors with level of importance score of 3.0 (all seven respondents assigned a score of 3). Those five factors are F9 "output specification implementation", F11 "clear and measurable outcome assignment", F16 "lump-sum payment system", F19 "budget availability certainty", and F21 "performance specification implementation." Bina Marga considered that these five factors play important role in ensuring that contractors will produce high quality/ performance work. In the end, this is believed to have an impact upon the long-term cost efficiency of road construction to the owners.

The number of drivers considered very important by the contractors in both pilot projects are considerably more compared to important drivers considered by owners. Only four drivers are considered quite unimportant, these are: F2 "Long-term contract", F3 "Large contract value", F12 "Implementation of incentive and penalty mechanism", and F20 "availability of robust road condition data".

Figure 2 shows comparison of opinions between the two sides. An interesting fact is that there are four drivers considered to be very important by all respondents, both owners and contractors, which are F9 "Output specification implementation," F11 "Clear and measurable outcome implementation," F19 "Guaranteed budget availability," and F21 "Performance specification implementation." Both sides were aware that successful implementation of PBC requires specific and fair rules regarding performance specification, scope, and long-term budget availability, as drivers and also as prerequisite due to the long-term nature of the contract.

Another thing which may be ascertained from Figure 2 is the difference in perception regarding the importance level of several driving factors (F4, F5, F6, F7, F8, F15, and F22).

Several facts from the discussions with the owners were further noted. In the case study, the level of competition among potential contractors during the procurement process was considered low and the selection of contractor was not mainly based on best value consideration but still relied on the lowest price elements. This has contributed to the less than satisfying result of contractor selection process. The contractors did not fulfill the owners' expectation on both sites. The owner learned that the selection process should have put more weight on contractors prior performance.

Another note on the Ciasem-Pamanukan project. The contractor believed that they provided work innovation through the use of "cakar ayam" foundation on areas with unstable soil condition. It was basically a floating concrete slab acted as foundation. However this initative was not seen as a positive thing by the owner; they consider that as not necessarily a new method or "innovative" thinking. This difference in perception has caused the contractor to feel underappreciated and further discussions of the possible innovative construction method did not follow.

Internal cooperation between firms within the joint operation (*Kerja Sama Operasional*) from the start was seen as a driver. Bina Marga specifically put requirements that contractors should form a joint operation between design firms and construction companies to retain a good constructability process. Despite that, integrated design and construction processes had not been optimally conducted on both pilot projects. Owners observed that both companies still work

separately in terms of time and space, which created a lack of meaningful collaboration on each company's scope of work.

VI. CONCLUSION

PBC can logically be seen as a form of alternative contract type which may deliver additional benefit/value (which may be followed by cost reduction) compared to the traditional type of contract currently in used in the delivery of national roads. From literatures, twenty driving factors for PBC implementation were been identified. These were confirmed in the case study, and two additional drivers were also identified. The lessons learned from the two pilot projects of PBC on Indonesian roads were mainly the importance for all parties involved to be open to the new rules of contract and to convince themselves about the potential increased benefits of the use of PBC.

According to the respondents, four driving factors are main prerequisite, i.e., "Implementation of output specification," "Implementation of clear and measurable outcome," "Budget availability," and "Implementation of performance specification. All four factors should be stated clearly within the PBC's clauses. A follow up study of detailed contract clauses needs to be conducted to ascertain whether or not the entirety of the standard contract documents have indeed accommodated all four main driving factors.

The pilot projects have also indicated that if the government will extensively implement PBC nation-wide, they should put more serious efforts to promote and socialize this new scheme to all stakeholders including convincing key personnel in the Ministry of Public Works, in the Ministry of Finance, and the legislative. The successful PBC on roads has to be supported with a change of our way of thinking in infrastructure investments. Long-term considerations and commitments will result in higher benefits to the public. If all parties are aware and willing to execute their roles, only then value-for-money can be achieved. The drivers have been identified, next, a quantitative evaluation scheme of PBC's effective implementation should be developed in order to provide sound justification of PBC as a more efficient and effective type of contract to support national roads management.

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