Cost control mechanism as procurement selection decision matrix for Malaysian infrastructure projects

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Abstract. Malaysia was enumerated as the realm that retains a high quality of infrastructure facilities among the other ASEAN countries, and the number of infrastructure projects is progressively developed to offers a virtuous cordiality to the citizen. Inevitably, the infrastructure projects are barely devoted to the complex project selection decision phase where the procurement represents the suave configuration of the projects. However due to the difficulty in analyzing an assorted variety of procurement system afford by inexperienced decision maker the procurement route often unkempt the cost related dynamic. Regularly, the decision based on narrow consideration of cost and project quality overestimated in within a short period of construction. Even worst, there is partially public discourse on the cost control elements towards the disputable project procurement selection, which reflects the lesson learnt on the previous infrastructure project has mismanaged to provide a municipal cost precaution.

Prior to that, the research objective is to identify the relationship in between the cost control mechanism and project procurement selection decision in infrastructure projects. The adoption of quantitative method and analysis applies in this research among the infrastructure expert settings. The output from the methods disclose that the cost control acquires a strong correlation in the project procurement selection decision equation with project risk, capital resources, alliance requirement based, changes of policy, fluctuation of inflation rates, labor cost, material cost, robust feasibility studies as a driver to an efficacious project procurement assortment verdict.

1. Landscape of infrastructure projects in Malaysia

Malaysia’s high worth of infrastructure is well prominence which the essence is entrenched from the national dogged pledge towards the 5 years gap of Malaysian Plan. The outstanding quality witness by the involvement of the private sector to share a financial burden on top of the partnership thrust. Notwithstanding the private sector often dominates on the project execution and infrastructure technicalities stocks, it has to be self-proclaimed that the private sector is the rampant organization that able to steer the national growth [1, 2]. The National Transformation of Malaysia (NTP) perceives that the transformation of the economy is impossible without a sturdy commitment towards the public services delivery [3, 4]. Therefore, in 2010 a New Economic Model (NEM) were introduced to aim a high profitability realm by year of 2020 [5]. The NTP are divided into two categories; Economic Transformation Programme (ETP) and Government Transformation Programme (GTP) which purposely enacted to transform the economy and the methods of government navigate the projects in
delivery of public services projects. By pursuing to attract investments exceeding USD 444 billion by 2020 and the opportunities for 3.3 million new jobs, all of the parties involved to fulfill the thrust expressly the Government-Linked Companies (GLCs) which expected to subsidize 60% of the total outlay to the infrastructure projects according to Malaysian Investment Development Authority Annual Report on 2016.

2. Procurement selection criteria in the cost control perception

Procurement facilitates the normal configuration and realization of the project, where the project is defined as the investment of resources for return [6]. Meanwhile in the context of construction, procurement is the outcome of a complex matrix of decision taking or by on behalf of the construction client. With all the dilemmas in the delivery of public infrastructure and although the project have been implemented vie new and innovative projects delivery approach like PPP, it is observed that relational contract element embedded in the current delivery approach in the public infrastructure delivery are best solutions of these problem [7]. The developer’s second major financial commitment is to place a contract to construct the development which can be understood via Table 1. From this point forward, some of the carrier flexibility will go although this does, to some extent, depend to the procurement route selected [8]. The selection of the procurement route needs to be early as to set up the initial team. Thus, a number of different procurement strategies are recognized and formalized [9]. These strategies come together with the appropriate procurement methodology. However, the cost dysfunction that can occur between these involved with the development of the business core and those involved with the project delivery as the formal and correct procedure will lead into true reflection of client’s objective.

The difficult in analyzing the pattern of procurement system were based on the procurement options, client’s characteristics, project requirements and external environments, clients or consultants often rely on their predictive judgment to select procurement systems for their construction projects [2, 10]. However, the decision override by in experience decision maker that chase over an aesthetic infrastructure rather than the cost basis [11]. Prior to limited discourse on the importance of the cost elements, a major development usually took over considerable time to complete a project where the is the bias factor existed in the selection consideration [8]. Hence, it is advisable to do cost control analysis before embarking the organization into a complex procurement system. Impacts on less appropriate selection of the project procurement systems involved negotiation, organizational arrangements; proper selection strategies and risk management increase the total costs of making transaction [12] and co- funding aid will be given according to appropriate procurement rules [13]. It would be difficult and impractical to select an infrastructure procurement route (eg : Emerging Cost Contracts, Design and Build and Engineering Procurement & Management Contract) without considering all the factors discussed.

The factors supported by [5, 6], according to Table 1 presented the performance expected by the owner is above the time and cost which it scored 45%. Meanwhile for the developer perspective, the concern more on the time because of the time would affect the cost and they rather care less about the performance. Besides that, for the investor point of view they concern more on the performance due to the performance will represented the infrastructure quality and function, with the high quality and best function ability then the income and profit will be generated after their capital investment on the infrastructure [14].

Hence, the procurement approach selection would play an important role in order to realize the desire of these stakeholders especially bringing back the return of the investment [15] and act as the cost control tools for the investors [16] and others collaboration partners. Thus, the cost control mechanism is viable to be studied in this particular research which the aim of this study is to classify the relationship in between the cost control mechanism and project procurement selection decision in infrastructure projects.
Table 1. Example of prioritized criteria by client type [6].

|                        | Owner Occupier (%) | Speculative Developer (%) | Investor (%) |
|------------------------|--------------------|----------------------------|--------------|
| Performance (function/ quality) | 45                 | 20                         | 50           |
| Time (certainty or speed)    | 25                 | 50                         | 30           |
| Cost (certainty or price)    | 30                 | 30                         | 20           |
| Total                     | 100                | 100                        | 100          |

3. Research hypothesis

Prior research evidenced that the cost control mechanism is the drivers for the project procurement selection infrastructure projects which major construction development consider the price control issue to complete the infrastructure project in the procurement selection [3]. The inexperienced decision – makers with limited knowledge on the procurement route require to adequately determine the elements of price control viability to enhance procurement selection decisions and reduce biases [7, 10]. Due to the fact that cost is the manipulating factor for successful project procurement selection [2,10,12] a hypothesis related to the cost control mechanism was developed. Measure based on the previous literature review, there are fourteen (14) numbers of cost control mechanism that is adaptable for the infrastructure project (refer section 5.3) to be tested under the hypothesis relationship correlation test. Therefore, the proposed hypothesis is as follows:

H01: There is a no relationship in between cost control mechanism and procurement selection decision matrix
HA1: There is a relationship in between cost control mechanism and procurement selection decision matrix

4. Research Methodology

By adopting a quantitative method, a questionnaire was formulated with the reliability test on the Cronbach Alpha has been distributed to the respondents. There are 60 numbers of the infrastructure practitioner which involving with the infrastructure projects for more than 30 years that agreed to return on the questionnaire survey. The output from the survey was recorded into a Statistical Package for Social Science (SPSS) software. Prior to the research requirements is to detect the relationship in between the project procurement selection and the cost control mechanism, a Spearman Correlation has been conducted. The Spearman Correlation has been used due to the monotonic relationship in two ordinal variables, which are non-parametric. The accomplishment of the correlation procedure is obligating the research to compute new variables on the average mean bivariate the elements. The results on the correlation are presented as follows:

5. Results and discussion

5.1. Demographic survey results

Among the 60 numbers of the respondents, there are 33% of them from the developer’s organization, 40% are contractors, and another 27% are consultant and the response rate are 100% as all of the questionnaire returned to the researcher although 13 numbers of the response were received later than the given timeline. The working experience of the respondents is unanimously around 10 to 20 years. The infrastructure projects implementation executed by the respondents are 15% for airports, 6% for seaports, 31% for railway, and another 48% is for the construction of motorways. The questions on the familiarity with the three-infrastructure project procurement are issued to the respondents. The results indicated that only 40% of them familiar with Engineering Procurement, and Management Contract, 30% for Design and Build and another 30% for Emerging Cost Contracts. The overall results show
that the response received from the developer, contractors and consultant are important and represent the voices from the construction infrastructure sector in Malaysia. With highly experience personnel who can be understood on the period of working experience and the massive involvement on the Malaysian leading infrastructure projects which unanimously on motorways construction, these results are deemed to convey a vast bearing on the future implementation infrastructure projects. The familiarity on the three main procurement routes are highly subjected to the utilization of the Engineering Procurement and Management Contract follows by equal distribution of percentage for the Design and Build and Emerging Cost Contracts. In order to gain deeper understanding on the three popular procurement routes, a survey on the cost satisfactory level on the selection of procurement are affords to attain the expert perception from the respondents. The results stated as follows:

5.2. Cost satisfactory level on the project procurement selection by the respondents

Figure 1 presents a cost satisfactory level on the project procurement selection responded by the respondents. For the Engineering Procurement and Management Contract there are 20 response on average, followed by 19 responses for fairly, 10 numbers for good and poor respectively, and 1 response for excellent. Meanwhile for the Design and Built, there are 28 number of responses for fairly, followed by 19 responses for average, 7 numbers of responses for good, and 5 numbers for poor and 1 number for excellent. For the Emerging Cost Contracts, there are 29 numbers of responses for the fairly, followed by 14 responses for average, 8 responses for poor, and 4 numbers of responses for excellent.

The results indicated that the overall satisfactory level for the infrastructure procurement route are on the fairly and average level. Only a small number of responses indicate that the procurement route is at the level of good and excellent. The satisfactory levels were rooted from the procurement selection decision which primarily the consideration made based on the factor of time, quality and cost. In this research, the cost perspective drives the procurement route selection and a survey on the perception of the respondent into the price control mechanism that effected the procurement selection decision was developed. The results are as follows:

![Cost Satisfactory Level](image)

**Figure 1:** Cost satisfactory level on the project procurement selection by the respondents.

5.3 The Relationship in Between the Project Procurement Selection Criteria and Cost Control Mechanism

Table 2 present the results on the Spearman Correlation in between the project procurement selection criteria selection criteria and cost control mechanism. A Spearman’s rho ‘r’ data analysis on Emerging Cost Contracts (n = 60) exposed a weak negative correlation with non-significantly correlated, for
CM1, CCM2, CCM4, CCM9, and CCM13. Besides that, results show a strong positive correlation with non-significantly correlated for CCM 4, CCM6, CCM7, CCM10, CCM11, and CCM12. There are 2 number of negative weak negative correlation with significantly correlated for CCM3 (r = -0.567, p=0.032) and CCM9 (r = -0.318, p=0.032), followed by a strong positive correlation with significantly correlated for CCM14 (r = 0.789, p=0.050). Meanwhile, for Design and Build (n=60), a Spearman’s rho ‘r’ data indicated that there are weak positive correlation with non-significantly correlated for CCM1, CCM2, CCM4, CCM6, CCM7, CCM8, CCM10, CCM13, CCM14. Other than that, a weak negative correlation with significantly correlated for CCM3 (r=0.587, p=0.011), and a strong positive correlation with significantly correlated for CCM12 (r= 0.755, p=0.017), and a weak positive correlation with significantly correlated for CCM11(r= 0.045, p=0.046). For Engineering Procurement & Management Contract (n=60), the value of ‘r’ Spearman rho exposes the strong positive correlation with non-significantly correlated for CCM2, CCM3, CCM6, CCM13 and CCM14, a weak positive correlation with non-significantly correlated for CCM4, CCM7, CCM9 and CCM10, a weak negative correlation with non-significantly correlated for CCM5, a weak negative correlation with significantly correlated for CCM6, and a strong positive correlation with significantly correlated for CCM8.

Table 2. The Relationship In Between the Project Procurement Selection Criteria and Cost Control Mechanism.

| Cost Control Mechanism       | Emerging Cost Contracts | Design and Build | Engineering Procurement & Management Contract |
|------------------------------|-------------------------|------------------|-----------------------------------------------|
| Code                        |                         |                  |                                               |
| CCM 1 Low Bid               | Correlation Coefficient | -0.002           | 0.043                                         |
| Sig. (2 tailed)              |                         | 0.980            | 0.655                                         |
| CCM 2 Fluctuation of inflation rates | Correlation Coefficient | -0.043           | 0.455                                         |
| Sig. (2 tailed)              |                         | 0.565            | 0.234                                         |
| CCM 3 Alliance requirement based | Correlation Coefficient | -0.567           | -0.587                                        |
| Sig. (2 tailed)              |                         | 0.032*           | 0.011*                                        |
| CCM 4 Project complexity     | Correlation Coefficient | 0.766            | 0.130                                         |
| Sig. (2 tailed)              |                         | 0.789            | 0.889                                         |
| CCM 5 Project Risk           | Correlation Coefficient | -0.433           | 0.577                                         |
| Sig. (2 tailed)              |                         | 0.705            | 0.339                                         |
| CCM 6 Project overhead prediction | Correlation Coefficient | 0.577            | 0.129                                         |
| Sig. (2 tailed)              |                         | 0.129            | 0.221                                         |
| CCM 7 Demand of the construction product | Correlation Coefficient | 0.577            | 0.404                                         |
| Sig. (2 tailed)              |                         | 0.129            | 0.236                                         |
| CCM 8 Robust Feasibility Studies | Correlation Coefficient | 0.787            | 0.981                                         |
| Sig. (2 tailed)              |                         | 0.556            | 0.223                                         |
| CCM 9 Fluctuation of interest rates | Correlation Coefficient | -0.318           | -0.043                                        |
| Sig. (2 tailed)              |                         | 0.032*           | 0.556                                         |
| CCM 10 Number of competitors | Correlation Coefficient | 0.700            | 0.655                                         |
| Sig. (2 tailed)              |                         | 0.988            | 0.162                                         |
| CCM 11 Material cost         | Correlation Coefficient | 0.787            | 0.045                                         |
| Sig. (2 tailed)              |                         | 0.556            | 0.046*                                        |
| CCM 12 Labour cost           | Correlation Coefficient | 0.577            | 0.755                                         |
| Sig. (2 tailed)              |                         | 0.129            | 0.017*                                        |
| CCM 13 Changes of Policy     | Correlation Coefficient | -0.455           | 0.566                                         |
| Sig. (2 tailed)              |                         | 0.276            | 0.234                                         |
| CCM 14 Capital resources     | Correlation Coefficient | 0.789            | 0.577                                         |
| Sig. (2 tailed)              |                         | 0.050*           | 0.129                                         |

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
Therefore, based on the hypothesis as follows;

H01: There is a no relationship in between cost control mechanism and procurement selection decision matrix.

HA1: There is a relationship in between cost control mechanism and procurement selection decision matrix.

The results on Emerging Cost Contracts indicated that there unanimously is weak positive correlation with non-significantly correlated, as well for the Design and Build route. Meanwhile, for the Engineering Procurement & Management Contract there are strong positive correlations with non-significantly on the CCM, dominating the list. Each of the procurement route gained 3 numbers of significant correlation disregards positive or negative, strong or weak relationship, respectively (CCM3= alliance requirement based, CCM9= fluctuation of interest rates, CCM14= capital resources, CCM11= material cost, CCM12= labour cost, CCM 1= low bid and CCM8= robust feasibility studies). Thus, the researcher manages to reject the hypothesis null, as there is a significant correlation in between the cost control mechanism (CCM) and procurement selection decision (PSD) matrix. The weak correlation in between the CCM and PSD matrix in this research sample may transpire by an existence of foreign probabilities or due to the existence of the other internal and external factors of the organization might highly influence the procurement decision [15], rather than all of 14 variables on the list. Thus, based on the results analysis, the researcher made a conclusion that in between three types of the procurement route, there is a relationship in between CCM and PSD matrix. However, among the PCMs’s in the three types of infrastructure procurement, there is a necessity to apprehend the mean weightage of the PCMs responded to afford an upgrading strategy [2, 16] to the PCM in the future. Hence, a network produced based on the significant mean value as follows.

5.4 Network Produced Based on the Relationship Correlation

Given the Likert scale value is 1 to 5 which represent the strongly disagree to strongly agree, the results indicated the price control mechanism drives the procurement selection decision at the highest mean value is at 4.27 for CCM 5 (project risk), followed by mean value of 4.25 for CCM 14 (capital resources), and 4.20 for CCM3 (alliance requirement based). Meanwhile, the top three from down on the list is at value of 3.21 for CCM 13 (changes of policy), followed by 3.23 for CCM 2 (fluctuation of inflation rates), and 3.56 for CCM 12 (labour cost). The results indicated that project risk, capital resources, and alliance requirement based are the price control mechanism that require a substantial highlights to select a better procurement route, meanwhile CCM of changes of policy, fluctuation of inflation rates and labor cost are among the CCM that the infrastructure practitioner can deal with independently which least affected the project procurement selection decision as shown in Figure 2.

6. Research Limitation

This research only conceals on the infrastructure projects with selected procurement route, which in the future the replication of this research shall be execute on housing projects and commercial projects to find the price control mechanism in those criteria as the demand of the housing and commercial projects are presently great in Malaysia.

7. Conclusion

The cost control mechanism act as the investment shield for the infrastructure to have an unblemished picture on the forthcoming procurement selection impacts, without rejecting the time and quality basis as the key determinant for an improve infrastructure projects delivery [6]. Thus, enforcement on the project risk, capital resources, alliance related, policy amendment, oscillation of inflation rates [10,16], operational cost on labour and material, and a feasibility studies phase are momentously vital.
Figure 2. Network produced based on the relationship correlation.

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