MULTI-TIERED PROJECT DELIVERY SYSTEMS SELECTION FOR CAPITAL PROJECTS

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ABSTRACT

This paper describes a method for selection of most suitable project delivery systems for capital projects. It expands upon the method advanced by the Construction Industry Institute (CII) in 2003, and incorporates additional decision criteria and project delivery systems in a multi-tier decision computational platform. The paper integrates the analytical hierarchy process to alleviate the inherent subjectivity associated with the assignments of relative weights to selection criteria used in the CII method. It also expands the range of project delivery options to include Public Private Partnership (PPP) and Integrated Project Delivery (IDP). The range of selection criteria was expanded by 60, beyond the 20 criteria of the CII method. Relative effectiveness values are proposed for the added project delivery systems making use of recent project cases in Canada and the USA. The method was implemented in a spreadsheet application. Multiple scenarios were considered for one of the cases presented in the CII study and a sensitivity analysis performed based on the developments made in this paper. The differences in outputs between the CII method and the proposed method are discussed. This is the first decision framework that incorporates both the presently used PPP and the recently introduced IDP, along with the widely used project delivery systems. The developed method allows users to filter out the factors and alternatives that do not apply to the case at hand, based on key inputs at the upper tier. The method is flexible and can easily be expanded upon and customized by the user.

KEYWORDS

Project delivery systems, Decision support, Multi-attributed, Capital projects, Analytical hierarchy process

INTRODUCTION

The definition of a project delivery system (PDS) by Clough states that "A project delivery option is a method for procurement by which the owner's assignment of "delivery" risk and performance for design and construction has been transferred to another party (parties)," (Clough, 1981, Mahdi and Alreshaid, 2005). The literature sources largely agree that, for each particular project, there may be a PDS that is the most suitable, and not one single PDS suits every project. PDS's continue to evolve and new ones emerge. Various factors influence the suitability of a PDS for a specific project, and therefore affect the selection. As the project size, complexity and the level of risk increase, and particularly if the project is public, owners approach the PDS selection with greater rigour. A proper choice of a PDS may significantly affect the project success, including meeting its targeted time, cost, and quality objectives and minimizing claims and disputes.

The method for PDS selection proposed in this paper is a development based primarily on the method described in the Construction Industry Institute publication CII Implementation Resource 165-2, Owner's Tool for Project Delivery and Contract Strategy Selection User's Guide (2003), which will be referred to as the CII Tool. The CII Tool uses the term Project Delivery and Contract Strategy (PDCS) and it defines twelve PDCS options (1 Traditional Design-Bid-Build [DBB], 2 Traditional with Early Procurement, 3 Traditional with Project Manager, 4 Traditional with Construction Manager, 5 Traditional with Early Procurement and CM, 6 CM @ Risk, 7 Design-Build or EPC, 8 Multiple Design-Build, 9 Parallel Primes, 10 Traditional with Staged Development, 11 Turnkey, and 12 Fast Track), and twenty factors for selection of the most suitable PDCS (1 Control cost growth, 2 Ensure lowest cost, 3 Delay or

minimize expenditure rate, 4 Facilitate early cost estimates, 5 Reduce risks or transfer risks to contractor(s), 6 Control time growth, 7 Ensure shortest schedule, 8 Promote early procurement, 9 Ease change incorporation, 10 Capitalize on expected low levels of change, 11 Protect confidentiality, 12 Capitalize on familiar project conditions, 13 Maximize Owner's controlling role, 14 Minimize Owner's controlling role, 15 Maximize Owner's involvement, 16 Minimize Owner's involvement, 17 Capitalize on well defined scope, 18 Efficiently utilize poorly defined scope, 19 Minimize number of contracted parties, and 20 Efficiently coordinate project complexity and innovation). The CII Tool provides relative effectiveness values (REV) of each PDCS with respect to each selection criterion on a scale of 0 (lowest) to 100 (highest), in the increments of 10, which are considered as industry-wide and independent of specific circumstances. The CII Tool recommends that between four and six selection factors be chosen for each project, and that no two factors should be based on the same objective or idea, to avoid double counting. The chosen selection factors are ranked in the order of importance and assigned preference scores, such that the most important gets the score of 100, the scores of the remaining factors follow in the increments of 5 or 10, and the lowest score is not less than 5. The CII Tool does not suggest a specific method for determining preference scores of selection factors (CII 2003).

To improve the objectivity of determining preference scores of selection factors, the method of analytical hierarchy process (AHP) is proposed. This is a method for selecting one among a number of alternatives, developed by Thomas Saaty, which incorporates a way of determining the relative weights of selection factors through pair wise comparisons. When comparing each pair of factors, their relative importance is expressed either numerically or verbally as follows: Equally important - 1, Moderately or slightly more important - 3, Strongly more important - 5, Very strongly more important - 7, and Extremely more important – 9, with the intermediate values 2, 4, 6 and 8. The reciprocals of these whole numbers similarly express lesser importance. The comparison judgements are recorded in n x n matrices, where n is the number of items to be compared. The headings for each row and column are the items to be compared in the same order from left to right and from top to bottom. By convention, each item of the row headings (on left of the matrix) is compared to each item of the column headings (above the matrix), and the numerical values are entered in each intersecting cell of the upper right triangle of the matrix. The bottom left triangle values follow directly from the upper right triangle. If A compared to B gives X, then B compared to A gives 1/X. Comparison to itself means equal importance.

The AHP utilizes mathematical operations with matrices to compute the relative importance of the selection criteria and it includes a method of computing the level of consistency of the judgments, thus assisting the decision-maker to maintain the recommended level of consistency (Saaty, 2003). The theory also includes several approximate methods of calculating priorities based on pair wise comparisons (Saaty, 1980), which can easily be implemented in the same spreadsheet application that the CII Tool utilizes. The approximate method referred to as 'Good 2' has been shown to give results very close to exact. To apply this method, find the geometric mean of each row of the matrix and normalize the resulting numbers. The result for each row represents the priority of the item in that row (Saaty, 1980).

PROPOSED MULTI-TIER SELECTION METHOD

Multi tiered process

Multi-tiered decision processes for PDS selection have been proposed by Ghavamifar (2009), and by Touran, Gransberg, Molenaar, Ghavamifar, Mason, and Fithian, (2009). In the system proposed here, the multi-tiered process represents a sequence of steps, structured so that certain clear and basic facts about the project can serve to simplify the selection process. The aim of the first tier is to determine whether or not to pursue PPP delivery, and it represents a sequence of questions in a specific order. The second tier solicits the key inputs, answers to ten questions, most of which do not require a great amount of judgement or research on the part of the user. A number of these ten questions include follow-up questions. Based on key inputs, certain PDS choices as well as certain selection criteria may be removed from further consideration, as not applicable. The third tier is similar to the original CII Tool – preference scores of the

selection criteria are determined, from which follow the ratings and ranking of the PDS alternatives. Depending on the results of the first tier, the third tier may represent either one of the two parallel decision processes - a selection from among the PPP options or from among the options other than PPP, or both of these processes. Further description of the three tiers is included in the case study.

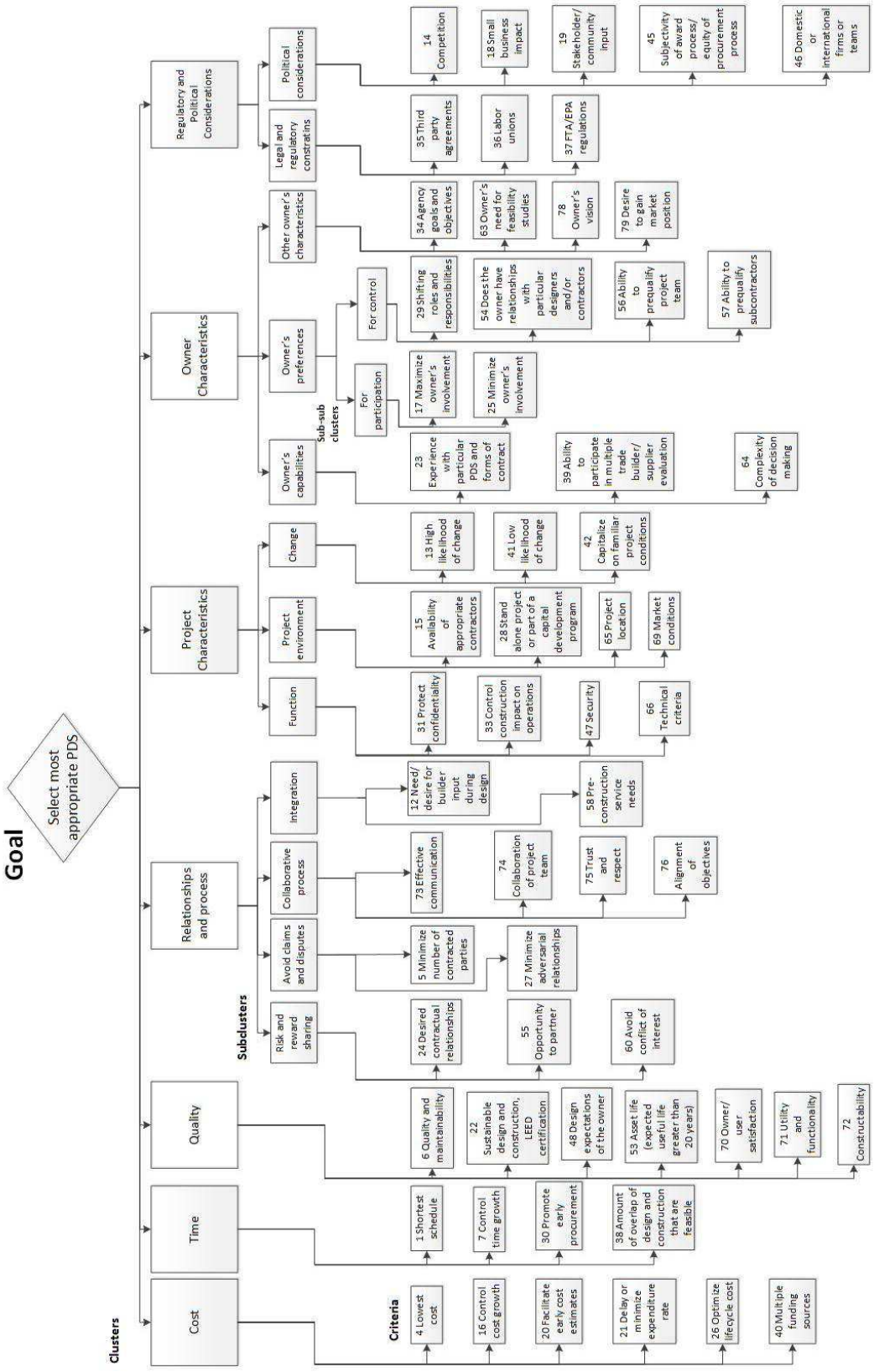
Expanded list of Project Delivery Systems

Several PDS options in addition to those included in the CII Tool have been identified through a review of literature and included in this decision support system to develop a comprehensive system relevant to the current state of practice. The system can be further adapted to future developments. These PDS's are Owner-build (OB), Design Negotiate Build (DNB), Integrated Project Delivery (IPD) and the public private partnership (PPP) options including: Build-Finance (BF), Design-Build-Finance (DBF), Design-Build-Operate (DBO), Design-Build-Operate & Maintain (DBOM), Design-Build-Finance-Maintain (DBFM), Design-Build-Finance-Operate & Maintain (DBFOM), Build-Operate-Transfer (BOT), and Build-Own-Operate-Transfer (BOOT). The names of the OB and DNB suggest their distinguishing characteristics rather well. The IPD is distinguished by a contractual arrangement that includes, at least the owner, constructor and design professional and aligns business interests of all parties. It is intended to motivate collaboration throughout the design and construction process by tying stakeholder success to project success. Its contractual principals are: key participants bound together as equals, shared financial risk and reward based on project outcome, liability waivers and fiscal transparency between key participants, their early involvement, jointly developed project target criteria, and collaborative decision making. (Joint Committee of the AIA and GSA, 2011). Very few projects to date have been delivered in a manner that completely corresponds to this definition of IPD. However, some of the IPD key principles have been applied on certain projects, most of which are still under construction or recently completed (AIA, AIA Minnesota, 2012). PPP pertains to public projects. Its distinguishing characteristics is the participation of a private sector entity providing services and products beyond those of design and construction, and it may include any combination of financing, maintenance, operation, and ownership as the above listed PPP categories suggest.

Expanded list of Selection Criteria

The review of literature also served to compile an expanded list of the criteria or factors relevant in selecting a PDS. These criteria are grouped into the following clusters: Time, Cost, Quality, Relationships and process, Project characteristics, Owner characteristics, and Regulatory and political considerations. For the Tier 3 process, the criteria are organized in a hierarchical structure to allow the AHP to be implemented (Figure 1). The clusters are compared to each other, and similarly the subclusters within a cluster and the criteria within a cluster or a subcluster are compared. The number of items to be compared with one group is never greater than seven. These comparisons on multiple levels allow the priorities of all the criteria within the system to be calculated. The decision support system includes explanations of all the criteria to enable their clear understanding and consistent use. The criteria which were designated as key inputs are excluded from the Tier 3 process. The relative effectiveness values for the additional selection factors and the additional PDS's were assigned based on information from the literature and expressed as low, medium-low, medium, medium-high and high. These verbal values were converted to numerical values as 20, 35, 50, 65 and 80 respectively.

Figure 1


Goal
Select most appropriate PDS
Clusters
Cost
Time
Quality
Relationships and process
Project Characteristics
Owner Characteristics
Regulatory and Political Considerations
Subclusters
Risk and reward sharing
Avoid claims and disputes
Collaborative process
Integration
Function
Project environment
Change
Owner's capabilities
Owner's preferences
Other owner's characteristics
Legal and regulatory constraints
Political considerations
Sub-sub clusters
For participation
For control
Criteria
4 Lowest cost
1 Shortest schedule
16 Control cost growth
7 Control time growth
20 Facilitate early cost estimates
30 Promote early procurement
21 Delay or minimize expenditure rate
38 Amount of overlap of design and construction that are feasible
26 Optimize lifecycle cost
40 Multiple funding sources
6 Quality and maintainability
22 Sustainable design and construction, LEED certification
48 Design expectations of the owner
53 Asset life (expected useful life greater than 20 years)
70 Owner/ user satisfaction
71 Utility and functionality
72 Constructability
24 Desired contractual relationships
55 Opportunity to partner
60 Avoid conflict of interest
5 Minimize number of contracted parties
27 Minimize adversarial relationships
73 Effective communication
74 Collaboration of project team
75 Trust and respect
76 Alignment of objectives
12 Need/ desire for builder input during design
58 Pre-construction service needs
31 Protect confidentiality
33 Control construction impact on operations
47 Security
66 Technical criteria
15 Availability of appropriate contractors
28 Stand alone project or part of a capital development program
65 Project location
69 Market conditions
13 High likelihood of change
41 Low likelihood of change
42 Capitalize on familiar project conditions
23 Experience with particular PDS and forms of contract
17 Maximize owner's involvement
25 Minimize owner's involvement
39 Ability to participate in multiple trade builder/ supplier evaluation
64 Complexity of decision making
29 Shifting roles and responsibilities
54 Does the owner have relationships with particular designers and/or contractors
56 Ability to prequalify project team
57 Ability to prequalify subcontractors
34 Agency goals and objectives
63 Owner's need for feasibility studies
78 Owner's vision
79 Desire to gain market position
35 Third party agreements
36 Labor unions
37 FTA/EPA regulations
14 Competition
18 Small business impact
19 Stakeholder/ community input
45 Subjectivity of award process/ equity of procurement process
46 Domestic or international firms or teams

CASE STUDY EXAMPLE

One of the case study examples presented jointly with the CII Tool is considered to enable comparisons with the proposed method. The case is a Federal Courthouse, a new 205,000 sf facility for the GSA (General Services Administration, the division of the U.S. Federal Government responsible for providing building facilities to the civilian agencies of the Federal Government). This owner usually awards a contract to the lowest bidder, and typically retains the services of a construction manager (agent) to supplement in-house project management resources and to review constructability. The major project objectives, in the order of priority are 1) adherence to the budget, 2) conform to space allocation, 3) appearance of the building must project appropriate image, 4) accommodate special security requirements and 5) provide capability for future facility expansion.

Tier 1

The Tier 1 questions, designed to determine whether to pursue PPP, are as follows. Q1: Is this project public or private? - Public. Q2: Is there sufficient funding for the project? - Yes; this is an assumption. The case study states that adherence to the budget is the highest in the order of priorities of the objectives, and it can be assumed that the project budget is adequate.) Q2a: Would it be advantageous to pursue PPP, for reasons other than the lack of funding (for example, to keep funding available for other projects or programs, to take advantage of private sector efficiencies, or to transfer portion of the risk to the contractor? Lacking the actual information to answer this question, we will assume 'yes' in order to demonstrate the remaining questions. (Answer 'no' to this question would result in a recommendation against PPP). Q3: Evaluate appropriateness of PPP based on screening criteria. Is the project a candidate for PPP? The proposed system makes use of the screening criteria defined by the Canadian Council for PPP Business case development guide (2011), whereas similar guidelines have been defined by various agencies in several countries. The project successfully passes several of the screening criteria. Its size may justify the PPP process, performance requirements and use are expected to be relatively stable over time, the asset has an expected useful life greater than 20 years, and there is scope for innovation in design, construction and operations. However, some of the screening criteria are not favorable. For example, there is no scope for the private partner to generate additional ancillary revenues, the refurbishment cycle may not be predictable over time, as the owner needs a flexibility to incorporate new technologies and respond to new security requirements without the limitations of the maintenance contracts, but, most importantly, the ability to transfer the project maintenance operations to a private partner may be limited as the project is a high security facility. The PPP options that may be considered are build-finance (BF) and DBF. Q4: Perform market sounding. Is the market favourable? - An answer to this question requires research and investigation specific to time, location and other project specific information. We assume 'yes'. Q5: Assess project delivery models, PPP and others, by following the Tier 3 process. Short-list several PDS's including at least one PPP and at least one outside of the PPP. The results of the Tier 3 will serve as inputs for the following final steps of the Tier 1. Q6: Develop and perform a value for money (VFM) analysis comparing at least one PPP and at least one non-PPP option. Based on both the criteria based selection and the VFM, select the PDS. The principles and methods of the VFM analysis as well as the market sounding are outside of the scope of this paper, which focuses on selecting a PDS other than the PPP options.

Tier 2

The following are the Tier 2 questions and answers, including certain assumptions. Q1: Is this a public or a private project? - Public. Q1a: If public, are there restrictions regarding the use of certain PDS's? - No (An assumption, since no restrictions were mentioned in the case study). Nothing is removed. Q2: Are the scope and requirements defined sufficiently that the design can be developed without significant owner participation, (or could they be developed sufficiently before issuing an RFP)? – No. (The objective that the building must project an appropriate image may be interpreted in various ways and it is unlikely that there would be common understanding of what represents an appropriate image without owner's participation in design). DB, Multiple DB and Turnkey are removed as well as factors 25 Minimize Owner's Involvement and 41 Low likelihood of change. Q3: Does the owner wish to have

significant control of design throughout the design process? – Yes. (Similar to Question 2). Again, DB, Multiple DB and Turnkey are removed. Factor 25 Minimize owner's involvement is removed. Q4: Do you estimate the time for project completion to be sufficient for design to be completed before the construction starts? – Yes. (The case study description does not mention that the time is unusually short or that a strict completion date is critical). Nothing is removed. Q5: Do you plan to dedicate staff resources sufficient for your desired level of involvement in the project? – No. (In reference to the statement form the case study that the owner usually seeks to supplement his staff resources, and assuming that this would be true for this particular project). DBB, traditional with early procurement, multiple primes, fast track, OB, DNB, and IPD are removed. Q6: Are you comfortable with trying an unfamiliar method of project delivery on this project? - No (An assumption, since the case study mentions what the owner is familiar with. However, the opposite assumption would also be valid). Q6a: If no, select the PDS's that you are familiar and comfortable with. - DBB, Traditional with early procurement, Traditional with PM, Traditional with CM (CMA), Traditional with early procurement and CM, and Traditional with staged development. All other PDS choices are removed. Q7: Please select estimated project size category. - Medium (A 205,000 sf building is a medium or a large project for most owners, design professionals and contractors. For the GSA this is probably a medium size project.) OB is removed. Q8: Is this a complex project? - Yes (Special security requirements add a significant level of complexity). OB and DNB are removed. Q9: Does the owner prefer to transfer significant portion of the risk to the contractor or accept significant risk? - Transfer (This is an assumption, based on the fact that a public agency would be more risk averse than a private entity, since the government owners have a duty to be good stewards of public funds). DNB, OB and IPD are removed. 10) Please select the project type - Other (given the choices: industrial, transportation, hospitals, airports, other). Nothing is removed. Based on the answers, the only remaining PDS's for this particular case are Traditional with CM, Traditional with PM, Traditional with early procurement and CM, and Traditional with staged development. The only factors that have been removed are factors 25 and 41. The decision maker can simply proceed to select one of the four options. However, that would mean severely limiting the set of alternatives without an actual valid reason. By reviewing the questions and answers in this tier, we can trace that the answers to questions 6 and 6a introduced the most severe limitations. As this question refers to owner's preferences and not to true limitations, the owner could chose to modify such an answer to keep a greater number of available choices. We assume that the owner would decide to be open to using unfamiliar PDS's, so that no options would be removed by this question. If all other answers remain the same the following PDS's would be removed: Traditional DBB, Traditional with early procurement, DB, Multiple DB, Parallel primes, Turnkey, Fast Track, DNB, OB and IPD. The remaining options are: Traditional with PM, Traditional with CM (CMA), Traditional with early procurement and CM, CMR and Traditional with staged development. If the owner felt that this is still limited, he could reconsider some of his other key inputs. We will assume that he accepts this list of choices.

Tier 3

The Tier 3 utilizes the AHP to determine the preference scores of the selection factors and the relative effectiveness values of all the PDS choices with respect to each selection factor to rank the PDS's. The factors 25 Minimize owner's involvement, and factor 41 Low likelihood of change, which were found as not applicable based on the Tier 2 inputs were removed. Furthermore, the decision-maker should review all the factors and remove from further consideration those that don't apply based on his knowledge. In this case, the following were removed: 33 Control impact on operations, 35 Third party agreements, 40 Multiple funding sources, 63 Owner's need for feasibility studies, 65 Project location and 69 Market conditions. Pairwise comparisons were performed at four levels of hierarchy: clusters, subclusters, sub-subclusters (in one case only), and criteria. The results of this process are the priorities (preference scores) for all the factors considered. The comparison matrices and the calculations of the priorities were integrated in a spreadsheet application, which also includes the REV's in a comprehensive matrix of project delivery systems and the selection factors and calculates the ratings and rankings of the PDS's. The rating of each PDS is calculated in the same way as in the CII Tool - the sum of the products of the preference scores of each selection factor multiplied by the REV of the PDS in question for that selection factor. Table 1 shows the rankings and the preference scores of the selection factors. The values of the

original case study considering five factors are on the left and the values by the proposed method, showing the first 22 factors which account for 80% of the preference scores are on the right. The factors ranked 3 and 4 of the original example represent the key inputs for the proposed method and therefore are not included in the factors ranking by the proposed method. Scenario 3 represents the first set of pair wise comparisons interpreting the information in the case study. For example, if includes a judgement that cost is two times more important than quality. In the Scenario 4, introduced for a sensitivity analysis, quality is five times more important than cost, while all the other judgments are equal.

Table 1 – Selection factors rankings and preference scores

Factor ranking	Original CII Tool		Proposed Method			
	Scenario 1	Pref. scores (%)	Scenario 3	Pref. scores (%)	Scenario 4	Pref. scores (%)
	Selection Factors		Selection Factors			
1	Control cost growth	45.45%	Control Cost Growth	15.08%	Control Cost Growth	11.03%
2	Delay or minimize expenditure rate	27.27%	Delay or minimize expenditure rate	8.65%	Design expectations of the owner	7.29%
3	Maximize Owner's controlling role	13.64%	Security	7.03%	Security	7.15%
4	Project complexity or innovation	9.09%	Design expectations of the owner	5.17%	Delay or minimize expenditure rate	6.33%
5	Minimize number of contracted parties	4.55%	Optimize lifecycle cost	4.25%	Sustainable design and construction, LEED	4.91%
6			Protect confidentiality	3.52%	Utility and functionality	4.20%
7			Sustainable design and construction, LEED	3.48%	Quality and maintainability	3.80%
8			Facilitate early cost estimates	3.29%	Owner/user satisfaction	3.80%
9			Utility and functionality	2.97%	Protect confidentiality	3.57%
10			Quality and maintainability	2.69%	Optimize lifecycle cost	3.11%
11			Owner/user satisfaction	2.69%	Control time growth	2.68%
12			Control time growth	2.64%	Asset life (more than 20 years?)	2.51%
13			Labor unions	2.38%	Labor unions	2.42%
14			Owner's vision	2.32%	Facilitate early cost estimates	2.41%
15			Competition	2.03%	Owner's vision	2.36%
16			Subjectivity and of award	2.03%	Competition	2.06%
17			Lowest cost	1.90%	Subjectivity of award	2.06%
18			High likelihood of change	1.81%	High likelihood of change	1.84%
19			Maximize Owner's involvement	1.79%	Maximize Owner's involvement	1.82%
20			Asset life (more than 20 years?)	1.78%	Experience with particular PDS	1.79%
21			Experience with particular PDS	1.76%	Minimize number of contracted parties	1.51%
22			Minimize number of contracted parties	1.49%	Constructability	1.40%

COMPARISON OF THE RESULTS

The highest ranking factor is the same by both methods including both scenarios of the proposed method and the factor ranked 5 by the CII is ranked 22 or 21 by the proposed method. The relative weights of the factors (expressed as a percentage of the total of the preference scores) are generally lesser values by the proposed method, as it would be expected when a greater number of factors are being considered.

Table 2 shows four sets of the first five PDS rankings. The original CII Tool case study (Scenario 1) results are on the left. The Scenario 2 includes the same set of selection factors and their preference scores as those in the original CII example, but it also includes additional project delivery systems. The rankings on the right (Scenarios 3 and 4) are the results from the proposed selection system. However, when the Tier 2 key inputs are applied, the DBB, which is the PDS ranked the highest through the Tier 3 process, as well as the IPD and the Traditional with Early Procurement would be removed from consideration, and the second ranked Traditional DBB with Project Manager would be recommended. This would be a result of an assumed Owner's choice not to dedicate internal staff resources sufficient to meet his desired level of participation on the project, whereas in the case of an opposite assumption the DBB would be recommended as the most appropriate. The ranking of the first five PDS's is very similar in all four scenarios. The highest ranking is the DBB and the fifth ranked is the Traditional with early procurement. The second and third places are shared by the DBB w/CM and the DBB w/PM by the CII method, whereas, by the proposed method the DBB w/ PM has a slightly higher rating than the DBB

w/CM. The fourth ranked PDS by the CII method is Fast Track and by the proposed method (Scenario 3) the IPD is fourth. In general, the differences in the ratings between the PDS's are less pronounced by the proposed method, as can be expected due to a larger number of the selection factors that make up the rating. In spite of a significant variation in relative importance of the cost cluster versus the quality cluster of the selection factors between scenarios 3 and 4, the highest ranking PDS remained unaffected.

Table 2 – Rankings and ratings of highest five project delivery systems

	Original CII case study results		Original factors and their preference scores from the CII case study, additional PDS's		Proposed method			
	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
Rank	PDS	Rating	PDS	Rating	PDS	Rating	PDS	Rating
1	DBB	85.5	DBB	85.4	DBB	63.9	DBB	62.2
2	DBB w/ CM	77.3	DBB w/ PM	77.1	DBB w/ PM	62.9	IPD	61.6
3	DBB w/ PM	77.3	DBB w/ CM	77.1	DBB w/ CM	62.7	DBB w/ PM	61.5
4	Fast Track	69.5	Fast Track	69.7	IPD	61.5	DBB w/ CM	61.3
5	DBB w/ EP	63.6	DBB w/ EP	63.8	DBB w/ EP	60.0	DBB w/ EP	60.0

Abbreviations:

DBB	Traditional Design-Bid-Build
DBB w/ CM	Traditional Design-Bid-Build with Construction Manager
DBB w/ PM	Traditional Design-Bid-Build with Project Manager
DBB w/EP	Traditional Design-Bid-Build with Early Procurement
IPD	Integrated Project Delivery

CONCLUSIONS AND FUTURE WORK

A three-tiered decision support system for selecting the most appropriate project delivery system (PDS) for capital projects has been proposed; advancing a system previously developed by the CII (the CII Tool) by expanding it via additional selection criteria identified thought literature, additional PDS's including the modalities of public private partnership (PPP) and the recently pioneered Integrated Project Delivery (IPD), and introducing an objective way of determining relative weights of the selection criteria through the analytical hierarchy process using pair wise comparisons. The first tier is a decision whether to pursue PPP or not. The second tier of the process enables the decision-maker to filter out the criteria and the PDS's that are not applicable based on key inputs. The third tier ranks the PDS alternatives in the order of preference. The proposed system has been implemented in a spreadsheet application and integrated with the CII Tool. The same case study previously analyzed by the CII was analyzed through the proposed process and the results compared. The system is flexible and it allows new developments in the PDS's and their selection to be incorporated. Future work should analyze additional case studies and perform multiple sensitivity analyses to further refine the system. The relative effectiveness values for the additional selection factors and additional project delivery systems should be validated through methods such as expert surveys or panels and established to a greater level of confidence.

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