Choosing a project delivery system in a multi-project environment

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Public entities approach the choice of a project delivery system from different points of view. One approach is to systematically eliminate inappropriate methods for a given project from the list of six key delivery methods, followed by selection from those that remain of a workable project delivery system, coupled with definition of an appropriate scope of work and contract requirements. Other approaches involve a systematic analysis of project delivery system (PDS) with the goal of choosing the best PDS for a given project. Here, the authors describe their approach toward selection of such a PDS.

A project delivery system selection problem

There are numerous variants of the six key delivery methods (as designed by MIT's Civil and Environmental Engineering Department in the 1990s – further information available at **www.barchanfoundation.com**) available for infrastructure development. A question facing public agencies is: which PDS should be used to develop a specific infrastructure project? The answer to this question is critical because the right PDS can significantly increase project efficiency and success rate.

Choosing a proper PDS is, however, a difficult task for a number of reasons.

First, a PDS decision is often made early in the project planning phase when only limited

and imprecise project information is available. That information scarcity involves such factors as goals, timing and budget of the project, roles of the participants, the surrounding economic environment, and so forth.

Secondly, selecting the right PDS involves choosing between the infinite variety of PDSs.

Thirdly, the existence of dependencies among projects in a multi-project environment further complicates the decision-making process. Addressing these difficulties requires a systematic decision-support framework.

A PDS selection decision-support framework

The overall decision-support framework is composed of five distinct stages and gates (as shown in Figure 1). 'Stages' are where tasks are performed, and each of them is further broken down into a set of steps. 'Gates' are checkpoints where the outputs of each stage are discussed, validated and approved by decision makers.

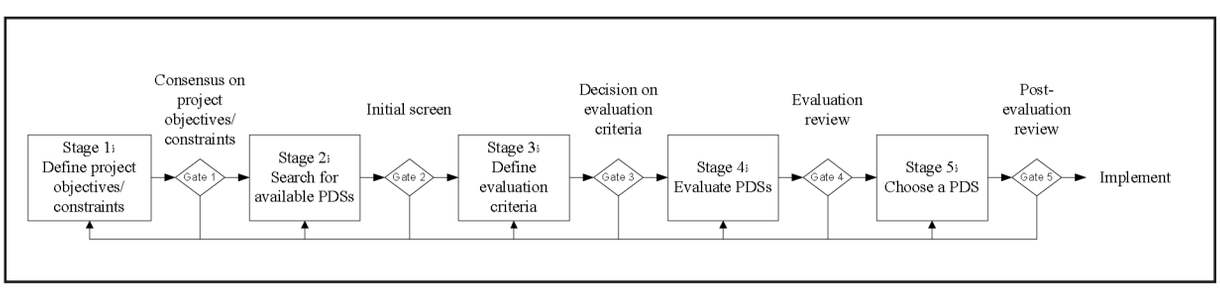

Figure 1. Overall PDS selection decision-support framework

Stage 1: define project objectives and constraints

The first stage towards a PDS decision is to define project objectives or constraints in terms of four categories: time, cost, quality and others. A project's objectives or constraints on time, cost and quality can be a range of values.

For example, the total project duration might preferably be 15 months but not exceed 30 months, and the total project cost might preferably be $5 million but not exceed $10 million. Some examples of other project objectives are: to seek innovation opportunities throughout the lifecycle, to minimise impact on the environment and/or to minimise inconvenience to the community and the public.

Stage 2: search for PDSs

The second stage is to develop a list of PDSs through a market search, a historical search, or both. These PDSs are then examined for their compliance with regulations. If the use of a PDS is prohibited by regulations, it is eliminated from the list. If the use of a PDS is only allowed under certain conditions (for example, requiring extra approvals), these conditions should be considered in the PDS selection process.

Stage 3: define evaluation criteria

In this third stage, a set of selection criteria that reflect the pre-defined objectives are defined. These criteria can be grouped into performance (PERF) and PDS criteria. PERF criteria include the three prime project performance measures: time, cost and quality.

With rare exceptions, PERF criteria are the project owners' primary concerns because they need to meet certain mandatory constraints. For example, a project has to be completed within a certain budget and by a specified deadline. The project also needs to meet a list of specifications to fulfil its planned purposes. How a project performs on PERF criteria is affected by the characteristics of a PDS (for example, how project phases are integrated) and several other factors (for example, project dependencies, time-cost trade-offs and external factors).

To integrate these factors into a PDS decision-making process, PERF criteria (except quality) are measured on a quantitative basis. For instance, time is measured in days, months or years and cost is measured in dollars.

Criteria other than time, cost and quality are grouped and defined as PDS criteria. Some common PDS criteria are time certainty, cost certainty, flexibility, complexity, risk avoidance, price competition and point of responsibility. The project performance on these criteria is largely determined by the characteristics of a PDS.

Because PDS criteria are mostly qualitative in nature, they are measured on a relative scale. The relationship between these two groups of criteria and the PDS decision, the factors affecting a project's performances on these criteria and how these criteria are measured are summarised in Figure 2.

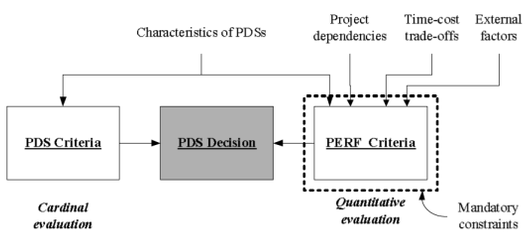

Figure 2. Two groups of evaluation criteria

Stage 4: evaluate PDSs on the two groups of criteria (PERF and PDS)

Dealing with PERF criteria

The initial step to evaluate PDSs on PERF criteria is to estimate project time (T), cost (C) and quality (Q), based on information from past similar projects. This information serves two purposes: first, it is used to derive time-cost trade-off rules, and secondly, it is used as a basis for further consideration of project dependencies. The second step is to identify dependencies between the new project and other ongoing projects. Next, the effects caused by these project dependencies on the new project's estimated schedule and cost must be identified, and necessary adjustments made by applying the predefined time-cost trade-off rules. Decision makers can also adjust the new project's estimated duration and cost for other desirable time-cost trade-offs.

The overall process is shown in Figure 3. This process is repeated for each of the PDSs under consideration. The final outputs are the new project's estimated durations, costs and quality levels under different PDSs. These results are presented in the form of a performance profile, as shown in Figure 4.

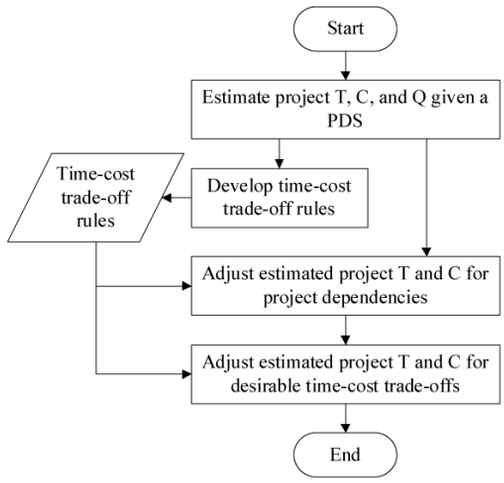

Figure 3. Process to deal with PERF criteria

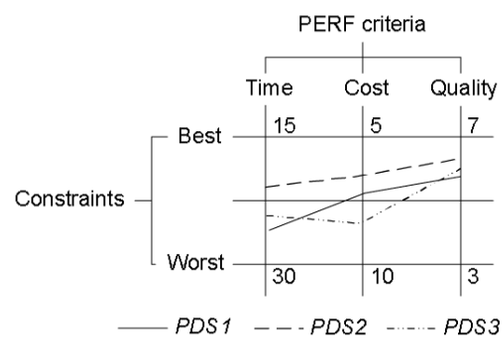

Figure 4. Performance profile of PERF criteria

Dealing with PDS criteria

A weighed score approach is used to evaluate PDSs on PDS criteria. In this approach, the criteria weights are first determined. Then the eligible PDSs are scored based on these criteria. Next, the scores for each PDS are multiplied by the criteria's corresponding weights to achieve weighted scores. These weighted scores are then summed to arrive at a total weighted score.

This result is also presented in a form of performance profile, as shown in Figure 5. The positions of PDSs on the line indicate their relative overall performances on PDS criteria.

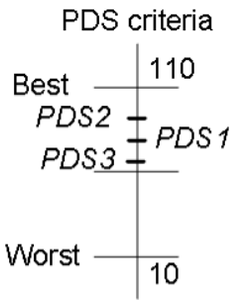

Figure 5. Performance profile of PDS criteria

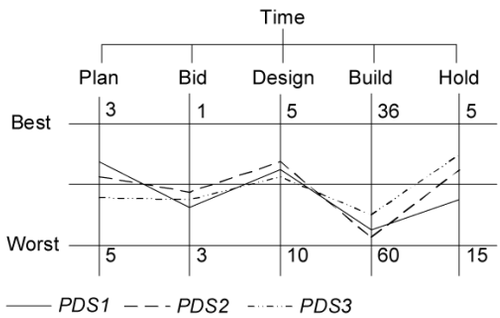

Figure 7. A example break-down performance profile of time criterion

Stage 5: choose a PDS

PDSs' performance profiles on PERF and PDS criteria are combined to produce an overall performance profile. One such example is shown in Figure 6. In a performance profile, a PDS that dominates all others on all criteria (for example, PDS2 in Figure 6) is considered as the most appropriate PDS. If no single dominant PDS exists, decision makers can scale the performance profile to indicate the criteria weights. A weighted performance profile can help decision makers distinguish the differences between PDSs and identify the stronger PDS.

If necessary, the overall performance profile can be broken down to visualise PDSs' performances on individual criteria. For example, the time criterion can be broken down to show a project's planning, design, bid and construction durations under different PDSs, as presented in Figure 7.

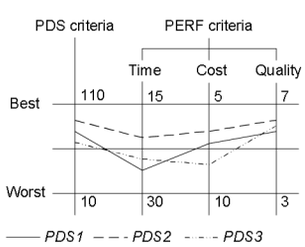

Figure 6. PDSs' overall performance profile

Benefits of the framework

This decision-support framework is beneficial to PDS decision makers in several ways. First, it guides decision makers, step-by-step, in evaluating alternative PDSs considering multiple criteria. Furthermore, it integrates the considerations of project dependencies and possible time-cost trade-offs into the PDS decision-making process.

This, all together, allows decision makers to choose a PDS on a more informed and systematic basis. As such, the possibility of an inappropriate PDS being implemented can be reduced. In addition, the presentation of PDS performance profiles also helps decision makers identify the criteria on which a PDS may perform poorly once it is selected. This provides to decision makers the opportunities to develop appropriate proactive strategies.

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