DOES "FRONT-END PLANNING" WORK FOR THE SINGAPORE CONSTRUCTION INDUSTRY?

Bon-Gang Hwang*
Department of Building, National University of Singapore, Singapore

Jia Wei Ho
Vestian Workplace Services, Shanghai, China

ABSTRACT

While technology advancement resulted in a spiral increase of complexity in construction projects, it tends to be unmatched with an equal increase in planning effort, especially at the pre-construction stage. Front-End Planning (FEP) is relatively new to the Singapore construction industry and its importance is not well recognised. As a result, this study aims to identify the implementation status of FEP in the Singapore construction industry and to analyse its impact on project performance, in order to encourage more organisations to practice and benefit from it. A questionnaire was developed and 327 projects from 27 companies were investigated. The analysis result revealed that about 40% of the companies and projects surveyed practiced FEP. In addition, the analysis reported that FEP can reduce project schedule and cost by up to 15%. Recognising the implementation status and impacts of FEP will be a starting point to improve project performance and to better manage projects, ultimately allowing the Singapore construction industry to significantly increase opportunities for project success.

Keywords: *Front-End Planning, Project Performance, Construction Industry, Singapore.*

1. INTRODUCTION

Project planning provides a common reference point that is a basis for monitoring, control and corrective action (Githens and Rosenau, 2005). While professionals in the construction industry understand the need for planning, it has not been well materialised due to the fact that changes to original plans are inevitable. As such, making a significant effort for planning tends to be considered a challenging process as it also requires vast capital, human resources and time. Under this assertion, a need exists to increase the understanding of the benefits that FEP can bring in construction projects as importance of FEP tends to be neither well recognised nor emphasised in Singapore. More than often, people in the Singapore construction industry perceive that rare value is found in project planning, and they give such excuses that "We do not have sufficient time to plan now, and we will have lots of time to fix things up later." This must be a misconception that should be corrected as changes that occur in the later part of a project would be more costly and time-consuming than in its initial stage.

Therefore, the objectives of this study are: (1) to investigate the status of FEP implementation in the Singapore construction industry; and (2) to explore the impact of FEP on achieving project schedule and cost objectives. Recognising the implementation status and impacts of FEP will be a starting point to better manage projects, ultimately allowing the Singapore construction industry to significantly increase opportunities for project success.

* Corresponding Author: E-mail - bdghbg@nus.edu.sg

2. LITERATURE REVIEW

2.1. FEP DEFINITION

FEP is the process of developing sufficient strategic information with which owners can address risk and decide to commit resources to maximise the chance for a successful project (Gibson, 1995). FEP was identified by Construction Industry Institute (CII) as an area deserving study due to its place in the construction life cycle and its potential for increasing project cost effectiveness and productivity. According to Gibson (1995) the term FEP is often used synonymously with pre-project planning, front-end loading, feasibility analysis, programming and conceptual planning ("It should be noted that one of these synonyms for FEP, front-end loading, is frequently associated with a negative practice related to contract progress payments. The negative practice involves estimating an artificially high earned-value for the early activities in order to improve the cash flow and collect the profit at the beginning of the project. However, this term is widely used in planning and execution in the industrial projects sector to stress the fact that the early activities in a project actually do have a high value and will have a lasting effect on the project" (Griffith and Gibson, 2001)). Gibson (1995) also defined FEP as the process of creating, analysing, and evaluating project alternatives during the early planning phase to support a decision whether or not to proceed with the project and to maximise the likelihood of project success.

As efforts made in the early life cycle of a project can have a greater influence on the project outcomes than those made later, the goal of FEP is to better define the scope of work of a project in order to meet both owners' expectations and project requirements in terms of budget, time, and performance. The ability to execute the planning effort with the right team and the right dedication of resources is paramount to project success (Gibson, 1995).

2.2. FEP PROCESS

FEP requires multiple analysis perspectives. It is not a job of just one person, but multiple parties who provide inter-related project information. For instance, when estimating construction cost, the quantity surveyor requires a description of the project scope prepared by the architect as defined by the client, indicating that outputs from one party become inputs for another. It is usually a project manager or a project planner who will get advice from various consultants and specialists (engineers, architects, quantity surveyors, etc.) to direct processes of FEP. He/She must consider all possible project alternatives to identify an optimum project configuration.

According to Gibson *et al.,* (1993), the process of FEP can be divided into four main steps (1 - organise for FEP, 2 - select project alternative(s), 3 - develop a project definition package, and 4 - decide whether to proceed) and it is depicted as shown in Figure 1.

The first step is to select a team for FEP. Teamwork and communication are critical to the FEP process. When organising for FEP, a multi-disciplinary team consisting of appropriately skilled and experienced personnel is required. This means that operations, business, project management, technical, and, if applicable, key consultant personnel must be closely involved in FEP in the early process. All pre-project personnel involved in the process need to understand what activities occur, and what their roles and responsibilities are in the process (Gibson *et al.*, 1994). Gibson *et al.* (1994) further argued that for FEP to be successful, team continuity is necessary, and the team must be cultivated through team building and open communication. The project, business, and operations managers need to understand that they have different views concerning project success and project objectives. These views need to be communicated, and project representatives should agree on project objectives. This agreement can be achieved through project objective setting exercises during FEP that considers corporate guidance, and the views of project managers, business managers, and operations managers. It is important that the corporate goals and guidelines for FEP are well defined. Other factors such as poor business decisions, unreliable data, or other assumptions can also affect the success of the project. These factors should be addressed in FEP if possible.

In the second phase, the qualified teams of skilled and experienced personnel verify inputs to the FEP process, conduct analysis, and make recommendations to the decision makers. The technical requirements of the project are also identified. This includes the identification of license agreements, testing procedures, and any security/secrecy requirements that may be needed for the project.

The third phase would include one of the key tasks of FEP – to develop a detailed scope definition for the project. Project scope definition, the process by which projects are selected, defined and prepared for definition, is one key practice necessary for achieving excellent project performance (Merrow and Yarossi, 1994). Extraordinary risks are many times the result of unresolved scope issues or unforeseen conditions (Smith and Bohn, 1999). Poorly defined scope definition elements are identified during the Project Definition Rating Index (PDRI) evaluation process and should be treated as potential risk factors that might cause negative impact to project outcomes. It is also important that the FEP team expand the resources necessary to insure a well-defined project scope before an authorisation decision is made. In addition, a comprehensive project execution plan should be developed to carefully identify how the project will be executed.

The last stage of FEP would be to carry out feasibility studies on the project to assess the viability of various options and present alternatives and thus to decide whether or not to proceed with the project. These studies typically consider: building use; business justification; business plan; economic analysis; facility requirement; future expansion or alteration considerations; site selection considerations; and project objectives in order to address the mission need (Federal Facilities Council, 2003).

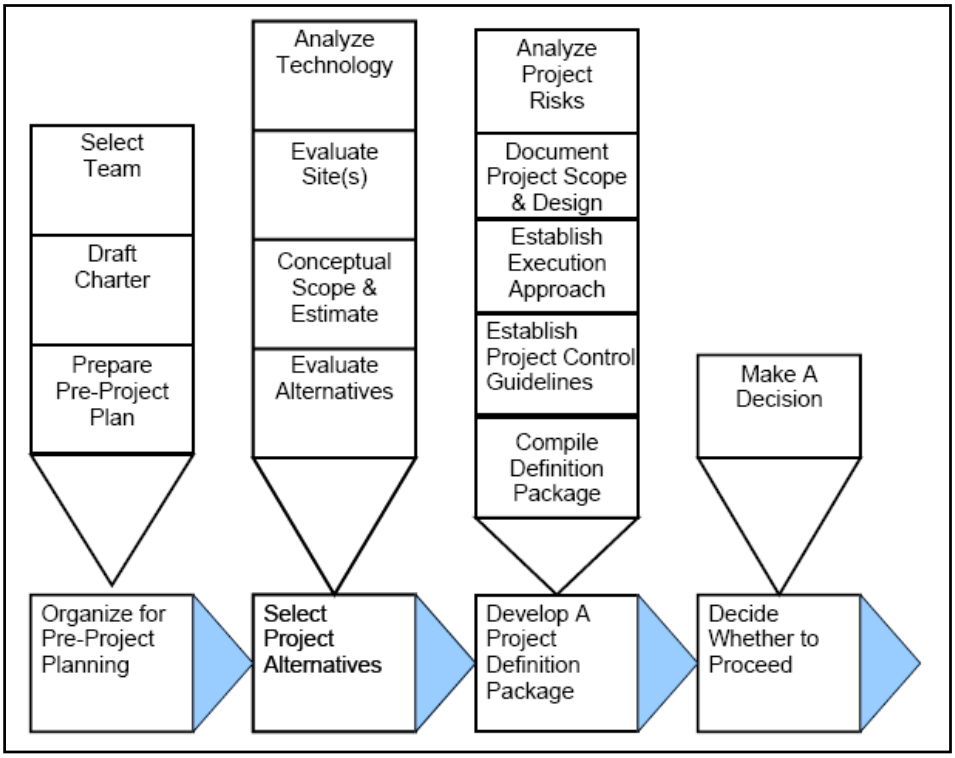

Figure 1: Front-End Planning Process (Source: Gibson *et al.*, 1993)

2.3. FEP BENEFITS

Several researches (Cho, 2000; Clarke, 1999; Gibson, 1994; Gibson *et al.*, 1994; Hartman and Ashrafi, 2004; Smith and Bohn, 1999) argued that FEP is a key element to improve project performance, increasing the likelihood of overall project success. Cleland and Ireland (2002) identified that decisions made early in the project process will, "…set the direction and force with which the project moves forward as well as the boundaries within which the work of the project team is carried out." Figure 2 depicts the conceptual relationship between influence and expenditure in a project life cycle.

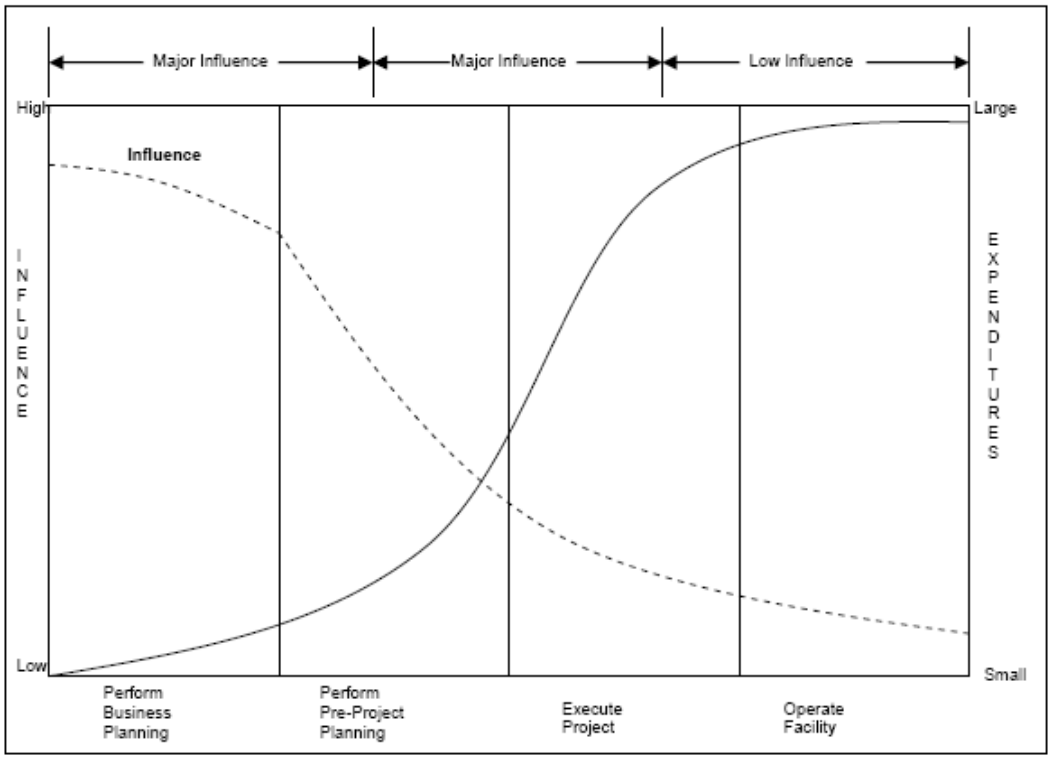

Figure 2: Influence and Expenditure Curve for Project Life Cycle (Source: Gibson *et al.*, 1994)

The curve labelled "influence" in Figure 2 reflects a company's ability to affect the outcome of a project during various stages of a project. The curve indicates that it is much easier to influence a project's outcome during the project planning stage when expenditures are relatively minimal than it is to affect the outcome during project execution or operation of the facility when expenditures are more significant (Gibson *et al.*, 1994). Experienced personnel within the construction industry believe that planning efforts conducted during the early stages of a project have much more effect on the success of the project.

Furthermore, FEP allows the project team to have greater influence over the project. Many potential problems are identified proactively before they can greatly affect project cost and schedule. Also, successful planning identifies which areas within the project need greater definition prior to execution. As the project enters the execution phase, the team has less influence to make low cost changes over the project (more costly to implement changes on the project). Figure 2 also illustrates this and the research done by Gibson and Hamilton (1994) also supports this relationship, arguing that more effort in project planning results in more successful projects.

Furthermore, according to Gibson *et al.* (1994), there is a positive co-relationship between the level of effort made for FEP and success rating for each project, as shown in Figure 3. Enhanced preparation can reduce the amount of change orders, misunderstandings, litigation and delays during project execution. Many studies have shown that poor project planning leads to large numbers of claims due to project specification and contractual incompleteness, and consequent adjustments, resulting in significant cost increases for the owners (Walrath, 2007).

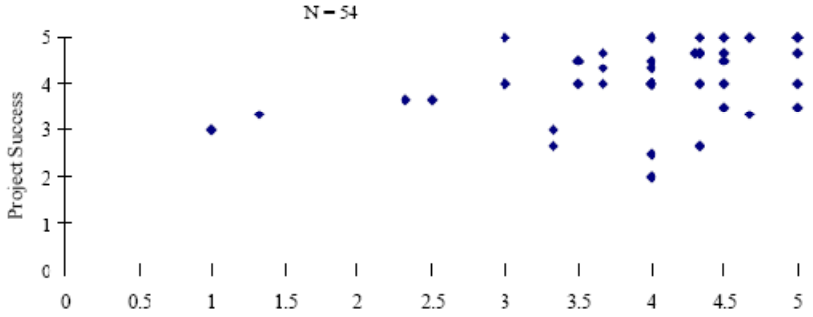

Figure 3: FEP Effort vs. Project Success (Source: Gibson *et al.*, 1994)

Some practitioners may argue that the amount of detail required for FEP increases project time and cost. However, such an assumption is considered as counterproductive. It may be true that time and cost may be up at the first instance of implementation, but from then onwards, the process would continue to improve performance, ultimately saving time and cost. Several experiences have shown that an investment in effective planning is fruitful and recording of achievements offers opportunities for improvement (Gidado, 2004). Good FEP can also reduce project complexity and project risk while project cost and schedule performance can be improved by 20% and 40%, respectively (Gidado, 2004; Gibson and Hamilton, 1994). More benefits that can be generated by the implementation of FEP have been identified by Walrath (2007) as follows:

- To alleviate information asymmetry between project partners;
- To ensure proper handling of the negotiation process and resolve intermediary agreements;
- To share the planning burden between involved project partners;
- To achieve a clear, optimised allocation of planning tasks to the proper, most proficient resource across organisations;
- To guarantee timeliness of invoking planning events and comprehensiveness of planning outcomes;
- To avoid an ad-hoc approach to contract definition;
- To foster knowledge retention across recurring projects within organisations;
- To enable industry-wide diffusion of best practices, thus increasing quality and productivity in Architecture, Engineering and Construction (AEC); and
- To increase transparency and mutual understanding of project expectations.

2.4. IMPLICATIONS OF FEP IN SINGAPORE

As every project in the construction industry is different and unique, different levels of planning are required for each endeavour and there is likely no single correct approach to planning a project and choosing the level of detail needed. While many studies discuss the implementation of FEP and its resulting benefits, these issues have been rarely explored in the context of the Singapore construction environment. According to Statistics Singapore (2009), the value of construction contracts to be awarded in 2011 and 2012 would be between S$21 billion and S$27 billion in 2011 and between S$18 billion and S$25 billion in 2012. Such a magnitude of capital expenditure confirms that the construction industry is one of the main pillars supporting economic growth and vitality in Singapore. Under this assertion, with recognition of the active utilisation and successful implementation of FEP in the U.S. construction industry, this study first explores the implementation status of FEP in the Singapore market, then quantifies its importance and impact on project outcomes in the local context in order to apply the lessons learned to the Singapore construction industry.

3. RESEARCH METHODOLOGY

This study was done by completing two major phases. The first phase was to carry out a comprehensive literature review to establish a foundation for this study and develop a survey questionnaire that could collect data to be analysed for achievement of the objectives stated before. As the second phase, a survey was conducted with representatives from companies registered in the Building and Construction Authority (BCA), which is an agency under the Ministry of National Development in Singapore.

The questionnaire consisted of three main sessions. The first section captured the profile of respondents, companies and projects that the companies had performed for the past three years. The next section was composed of questions that could diagnose the status of FEP implementation in the reported projects as well as in the companies. Lastly, the impact of FEP implementation on project cost and schedule was quantified.

The data collection effort produced 27 completed questionnaires from 27 different companies. The survey required each participating company to complete the questionnaire by assigning a representative with sufficient knowledge and experience in the operations and work processes of the company. In total, respondents provided data on the outcomes of 329 projects. The profile of the companies and respondents is summarised in Table 1. The characteristics of the projects investigated for this study are provided later in Table 2, with the information of whether or not the projects implemented FEP.

Table 1: Profile of Companies and Respondents

Characteristics of Companies		**N**	**%**	**Characteristics of Respondents**		**N**	**%**
Work Type	Quantity Surveying	2	7%	Job Title	Managing Director	19	70%
	Project Management	2	7%		Project/Construction Manager	5	19%
	Construction Contractor	23	86%		Project Engineer	2	7%
					Not Specified	1	4%
Tendering Limit	Unlimited	5	19%	Years of Experience	Less than 10 years	8	30%
	Up to S$40 million	9	33%		10 - Less than 20 years	17	63%
	Up to S$4 million	13	48%		20 years and above	2	7%

4. PRELIMINARY FINDINGS

4.1. CURRENT AND FUTURE IMPLEMENTATION OF FEP

The survey result revealed that at the company level, 12 companies (44%) out of the 27 companies surveyed practiced FEP while 131 projects (40%) out of a total of 329 projects were completed with implementation of FEP.

Table 2: FEP Implementation Status at the Project Level

Chracteristics of Projects		**No. of Projs.**	**FEP Implemented**		**FEP Not Implemented**	
			No. of Projs.	**%**	**No. of Projs.**	**%**
Type	Building	247	112	45%	135	55%
	Infrastructure	47	3	6%	44	94%
	Industrial	35	16	46%	19	54%
Size	Less than S$5 million	277	119	43%	158	57%
	S$5 - Less than S$15million	39	12	31%	27	69%
	S$15 - Less than S$50 million	11	0	0%	11	100%
	S$50 million and above	2	0	0%	2	100%
Nature	Addition	163	53	33%	110	67%
	Grass roots	81	5	6%	76	94%
	Modernization	85	73	86%	12	14%

According to the three major project types as shown in Table 2, FEP was implemented more to building (45%) and industrial projects (46%) than infrastructure projects (6%). Here, building projects include those of high rise offices, schools, hospitals, hotels and retail. Infrastructure projects include highways, roads, rails, tunnelling and bridges. Industrial projects include oil refinery, pharmaceuticals manufacturing and consumer products manufacturing. For building projects, requirements of users, for example, tend to be of top priority and thus planning should be done early to ensure that these needs will be met as the project proceeds. As for industrial projects, one of the reasons for doing more FEP might be due to the importance of long-lead items. Also, space for plants and major engineered equipment needs to be carefully planned to ensure optimal usage of the space as well as efficient arrangement of mechanical and electrical systems.

According to the different cost categories as presented in Table 2, it is of interest that the projects costing less than S$5 million implemented FEP more than the larger projects in terms of the total project cost. This is contrary to the belief that projects in larger scale may have a higher tendency of FEP implementation. One possible reason for the result might be the unbalanced sample size of the category. Nevertheless, this result proves that FEP can still be used for even small projects if it can help to increase the chances of project success.

Next, projects were investigated by their nature, namely Addition, Grass roots and Modernisation. Addition projects are those that include a new addition that ties in to an existing facility, often intended to expand capacity. Grass roots projects include a new facility from the foundations and up or a project requiring demolition of an existing facility before new construction begins. Modernisation projects are those that include a facility for which a substantial amount of the equipment, structure, or other components is replaced or modified, and which may expand capacity and/or improve the process or facility. As shown in Table 2, the highest percentage of FEP implementation was reported in the modernisation category. This might be due to the nature of modernisation projects that disruption to both users and production lines should be minimised to ensure continual operations. This may apply similarly to addition projects. While it was unexpected to observe less implementation of FEP into the grass roots projects, this might be due to the small sample size of the relatively large projects that tend to be grass roots project.

Respondents were also asked to assess the possibility of future implementation of FEP and the result is presented in Figure 4. Majority of the companies felt that there would be a future for FEP when the industry is educated on its benefits. However, there was one particular contractor who was uncertain about it and he felt that companies might not consider practicing FEP in their projects as it was more necessary for big projects consisting of several trades that have to be better coordinated and performed. The contractor reported that in small projects, works were direct and standardised, involving minimum coordination. Thus, procedures of works are most likely to be kept simple. As such, implementation of FEP may be irrelevant.

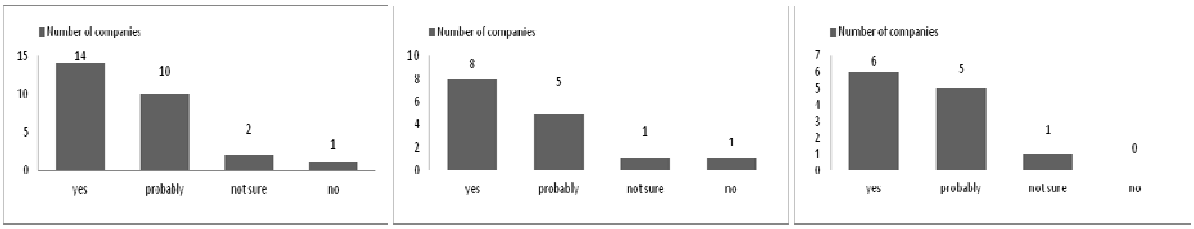

Figure 4: Future Implementation of FEP

4.2. THE IMPACT OF FEP IMPLEMENTATION

Following the analysis on the implementation status, the impacts of FEP on schedule reductions and cost savings were investigated. As the impacts were measured as percentage of schedule reductions and cost savings, the respondents were required to compare the planned budgets and durations of their projects with the actual costs and durations, respectively.

Table 3: The Impact of the Challenges on Project Performance

% of Schedule Reduction	All Companies			Companies Implementing FEP			Companies Not Implementing FEP			% of Cost Saving	All Companies			Companies Implementing FEP			Companies Not Implementing FEP		
	N	%	Mean	N	%	Mean	N	%	Mean		N	%	Mean	N	%	Mean	N	%	Mean
0%	6	22%	5.1%	2	17%	5.8%	4	27%	4.5%	0%	4	15%	5.7%	1	8%	6.1%	3	20%	5.4%
1%-5%	8	30%		3	25%		5	33%		1%-5%	9	33%		5	42%		4	26%	
6%-10%	11	41%		6	50%		5	33%		6%-10%	11	41%		4	33%		7	47%	
11%-15%	2	7%		1	8%		1	7%		11%-15%	3	11%		2	17%		1	7%	
>15%	0	0%		0	0%		0	0%		>15%	0	0%		0	0%		0	0%	

As shown in Table 3, ten out of the 12 companies that practiced FEP indicated that they could reduce their project durations by up to 15%, which is a bit low when compared to the 30% and 22% reductions claimed by CII (2010) and Ray *et al.*, (2006), respectively. As FEP can help to clearly define project scope, systematically identify potential risks, and effectively minimise changes, delays can be avoided and project schedules can be reduced.

In the case of cost savings, 11 out of the 12 companies implementing FEP reported that they could save project costs by up to 15%, with an average of 6.1%. CII (2010) argued that a maximum of 20% of total project design and construction costs might be reduced while the research done by Ray *et al.* (2006) reported that FEP can reduce the total costs of building projects by a maximum of 2%. Although previous studies report different levels of cost savings, this result provides positive evidence that should be used to encourage more industry players to implement FEP.

5. SUMMARY AND RECOMMENDATIONS

This study aimed: (1) to investigate the status of FEP implementation in the Singapore construction industry; and (2) to explore the impact of FEP on achieving project schedule and cost objectives. In general, about 40% of the companies and projects surveyed for this study practiced FEP. More specifically, at the project level, building and industrial projects tended to have higher implementation of FEP as compared to infrastructure projects. Modernisation projects in nature were also reported to have higher percentage of FEP implementation when compared to addition and grass roots projects. While the current implementation status in Singapore was relatively low, a potential for active implementation of FEP in the future was perceived through the survey. Furthermore, the analysis identified that FEP can reduce project schedule and cost by up to 15%.

Although the objectives of this study were achieved as summarised above, future studies are warranted. First, most of the respondents are from construction contractor firms and thus the results from the survey may represent more of contractors' perspectives on FEP. Considering that FEP tends to be driven by owners, perspectives of owners in implementing FEP should be investigated. Also, the projects investigated in this study are relatively small in terms of their size and more number of the building projects were analysed. Including large projects that probably require more planning effort will contribute to drawing solid conclusions. A balanced sampling among various types of projects will also be able to overcome the limitation of this study. Furthermore, the impact of FEP implementation on other project outcomes such as quality improvement and risk reduction should be further explored to better understand benefits of FEP.

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