

Retrospective look on front-end planning in the construction industry: A literature review of 30 years of research

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ABSTRACT

Academics and practitioners have paid close attention to front-end planning research, especially in the construction industry. It is known with many acronyms including pre-project planning and front-end loading. Since 1994, Construction Industry Institute (CII) has set front-end planning as one of the main research topic areas in their knowledge structure. A lot of research related to front-end planning and project scope definition has been conducted since then. However, there lacks a comprehensive review of the current studies on the topic. Thus, the objective of this research was to undertake a comprehensive literature review of papers related to front-end planning. Reviewing 83 selected papers, this research raises several important issues regarding front-end planning such as the position of front-end planning in project life cycle, the differentiation between front-end planning and project planning, the significance of front-end planning, the front-end planning organization management, the front-end planning phases, the challenges in front-end planning implementation, and the identification of research gaps in front-end planning. The findings of this research contribute to further understanding of front-end planning and would be useful for practitioners and academics to conduct further empirical studies on the subject matter.

KEYWORDS: Construction, Front-end loading, Front-end planning, Pre-project planning, Project planning.

INTRODUCTION

History of project failures is well documented. Generally, a project can be considered as a failure if it cannot meet its initial goals and objectives. Construction projects such as Sydney Opera House in Australia, The Big Dig in the United States (US), and Jakarta Monorail in Indonesia are some examples of project failures (Alexander, 2014; Bourne, 2007; Flyvbjerg, 2014; Poole & Samuel, 2011) that resulted in losses for stakeholders. Conversely, on a more positive note, these project failures could serve as lessons learned for construction professionals in managing construction projects.

Studies have shown that many large infrastructure projects failed in its planning and execution stages (Flyvbjerg, Bruzelius & Rothengatter, 2003; Gibson, Bingham & Stogner, 2010; NRC, 2003) due to the fact that modern projects are usually very complex and have a high level of uncertainty and interdependency. Previous studies have also examined the influence of project planning on project execution success and suggested that effective Front-End Planning (FEP) can enhance project performance (Gibson, Wang, Cho & Pappas, 2006; Sherif & Price, 1999). It has been argued that ‘doing the right project’ is equally important with ‘doing the project right’ (Williams & Samset, 2010). Infrastructure projects must, therefore, be carefully planned and right decisions made early. Ineffective FEP can impact on the next project phases or even

lead to implementing the wrong project (Williams & Samset, 2010). Hence, it is pertinent that key stakeholders and project managers pay attention to good FEP implementation.

Although it has been widely studied, previous research by Edkins, Geraldi, Morris and Smith (2013) proposed that FEP practice has been poorly understood and is often inconsistent. There is a lack of clear understanding and effective guidance about FEP. Therefore, this paper aims to present a retrospective look at FEP in the literature over the past 30 years in order to provide a better understanding of the concepts and issues related to FEP.

This paper begins by describing the integrated literature review method adopted in this study. It then presents the key findings from this review in which seven key themes of FEP were identified. These seven key themes cover issues related to project planning vs FEP, the significance of FEP, FEP organization management, FEP phases, FEP implementation and practices, and challenges in FEP implementation. Finally, it concludes by suggesting potential direction for future research on FEP.

METHODOLOGY

This research adopted a qualitative approach to identify FEP issues. Specifically, it follows the Integrative Literature Review Approach to review, critique, and synthesize the related literature in an integrated way so that new perspectives can be produced (Torraco, 2005). To ensure appropriate literature are included in the review, a systematic process used by Le, Shan, Chan and Hu (2014), Osei-Kyei and Chan (2015) and Chan and Owusu (2017) were employed to guide the selection of literature relevant for this study. Explicitly, this study was conducted in five phases as follows.

Phase 1: Searching for Target Literature

At this phase, the relevant papers from target journals were retrieved. The journals considered for the review were those peer-reviewed journals that have their own virtual libraries (VLs). These VLs includes the Emerald, ASCE Library, Taylor and Francis, Elsevier, Wiley-Blackwell, SAGE, and SCIRP. For instance, the journals identified in ASCE Library includes: Journal of Construction Engineering and Management, Journal of Management in Engineering, Journal of Infrastructure Systems, Journal of Performance of Constructed Facilities, and Journal of Architectural Engineering. Table 1 shows the summary of these target journals.

Additionally, other types of publications were also identified as literature sources. These included: conference papers (mainly ASCE Conference series, ARCOM Conferences, Project Management Institute Annual Conferences), institution web sources (CII, The World Bank), theses or dissertations, and published books.

Table 1: Summary of target journals based on the VLs (Researchers' work, 2018)

No.	VLs/Publishers	No. of Journals	No.	VLs/Publishers	No. of Journals
1	Emerald	7	5	Wiley-Blackwell	2
2	ASCE	5	6	SAGE	1
3	Taylor & Francis	5	7	SCIRP	1
4	Elsevier	4			

Phase 2: Searching for FEP Literature

Next, the search engines for each journal and source were located and some keywords were used to narrow the search. These keywords were ‘front-end planning’, ‘front-end loading’, ‘pre-project planning’, and ‘project planning’. The literature search was limited from the year of 1986 to 2017. These papers were then imported to Endnote X7 software.

Phase 3: Selecting Relevant FEP Literature

At the end of the initial search, an examination involving visual examination i.e. reading the abstracts or document summaries, were conducted to sieve the papers. This is done to identify relevant papers that are more aligned to the subject matter. A total of 83 publications that meet the criteria were selected for further review in this study. Table 2 shows the top five search results from target journals identified.

Table 2: Search results of relevant publications (Researchers’ work, 2018)

No	Name of Journal	Number of initial searches	Number of selected papers
1	Journal of Construction Engineering and Management	36	7
2	Journal of Management in Engineering	22	8
3	International Journal of Project Management	17	4
4	Journal of Construction Management and Economics	11	1
5	Project Management Journal	6	4

Phase 4: Analysing the Content of Selected literature

Thematic coding technique was used to analyse the content of the selection publications. Significant ideas, issues, phenomena, etc. in the text were coded. The selected publications were further analysed and grouped into categories based on common themes. Figure 1 below shows an example of the coding process conducted in this research.

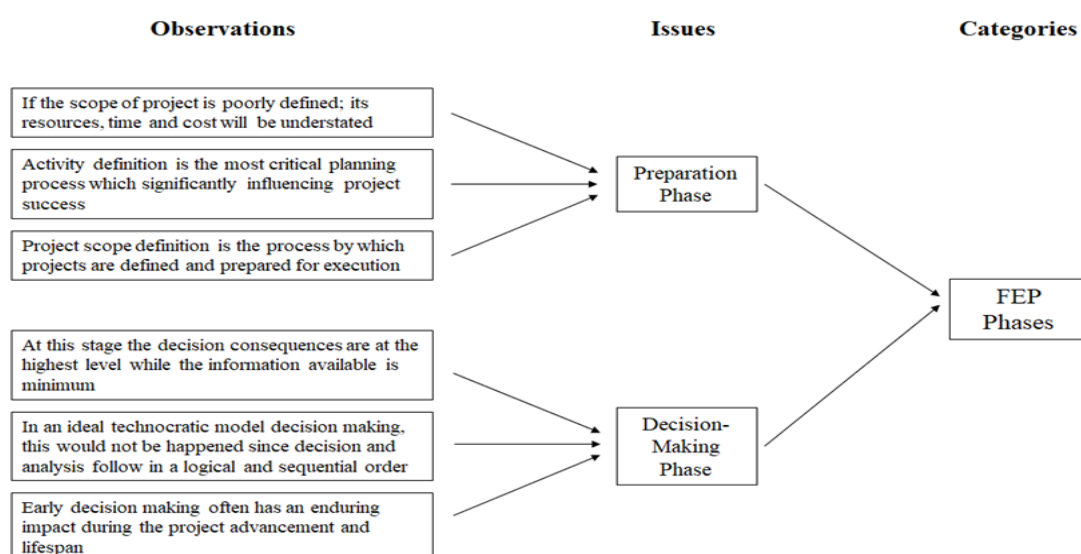


Figure 1: Example of the coding process (Researchers’ work, 2018)

Phase 5: Report Findings and Recommendations

Finally, the researchers reported the findings and recommendations. The findings and recommendations were presented with respect to the surrounding issues of FEP in construction industry. They were presented in tables and figures and discussed in the 'Findings' section.

FINDINGS

The review identified seven key themes of FEP research in the last 30 years. They are: (1) project life cycle, project planning and front-end planning; (2) the significance of front-end planning; (3) front-end planning organization management; (4) front-end planning phases; (5) front-end planning implementation and practices; (6) challenges in front-end planning implementation; and (7) directions for future research.

Front-End Planning in the Project Life Cycle

A project life cycle represents the path a project takes starting from the beginning to its end. It is generally sequential and provides the basic framework for managing a project. A generic phase of project life cycle are initiation, planning, execution, and closure. However, different project types will have a variety of project life cycle. For instance, project life cycle in transportation projects typically have six phases, i.e.: needs assessment, feasibility/scoping, preliminary design, detailed design, construction, and operation & maintenance (Le, Caldas, Gibson & Thole, 2009). In addition to project life cycle, all project will be managed by five processes of initiating, planning, executing, monitoring & controlling, and closing which are used in every phase of the project. A decision whether to continue or not with a project may be made at the end of every project phase (Newell & Grashina, 2004).

Project initiation starts by the decision to build some facility. This decision is made based on previous judgment, knowledge and experience, and some cost-benefit evaluation. Next is the planning phase, followed by the execution phase and the closure phase. In ideal conditions, when a project is moving to the next phase, the degree of project definition is increased, while the amount of influence over the project outcomes is decreased. Therefore, the area with the highest opportunity to influence project outcomes starts from the initiation phase up to some extent of the planning phase, as depicted in Figure 1 (Newell & Grashina, 2004).

With a growing number of research projects on FEP, it is important to differentiate project planning and front-end planning. Meredith and Mantel (2006) defined project planning as 'the establishment of a set of directions in sufficient detail to tell the project team exactly what must be done, when it must be done and what resources to use in order to produce the deliverables of the project successfully.' According to Zwikael and Globerson (2006), project planning is a crucial stage in project life cycle. Extensive studies have identified planning as one of project's critical success factors (Johnson, Karen, Boucher, & Robinson, 2001; Meredith & Mantel 2006; Pinto & Slevin, 1989). Thus, the probability of a project to be executed properly will be increased with high quality of planning (Zwikael & Globerson, 2006; Zwikael, 2009). The major outcome of project planning is the project plan which contains elements of project overview, project objectives, project general approach, contractual conditions, project schedules, resources estimation, risk management plan, and evaluation methods (Meredith & Mantel, 2006). It is used to guide project execution from design through construction and closure (Liang & O'brien, 2016).

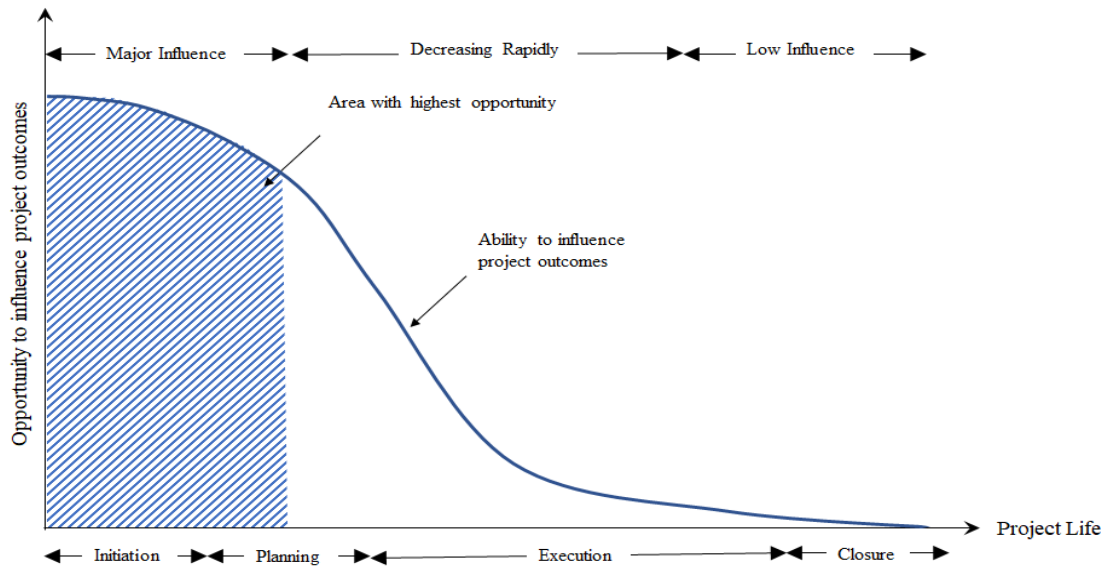


Figure 2: Ability to influence project outcomes over project life cycle (From Newell & Grashina, 2004)

While project planning is the second phase in project life cycle which involves organizing and preparing a set of plans to guide project team through the execution and closure phases of a project, FEP starts from the first phase in the project life cycle and ends with, to some extent, part of project planning phase. The first phase of a project is the initiation phase where a business problem or opportunity is identified and a business case defined (Westland, 2006). It is the conceptualization process of a project. According to CII (2014), Front-End Planning is ‘the process of developing sufficient strategic information with which owners can address risk and decide to commit resources to maximize the chance for a successful project.’ In other words, it is a process of analyzing and explaining project’s goals and strategies needed to achieve a successful end (Cleland & Ireland, 2002). It begins with the conception of a project, followed by information collection and stakeholders’ consolidation, and finally ends with the final decision to proceed with the project or not (Motta, Quelhas, Filho, Franca & Meirino, 2014). Figure 3 shows the position of FEP in the project life cycle.

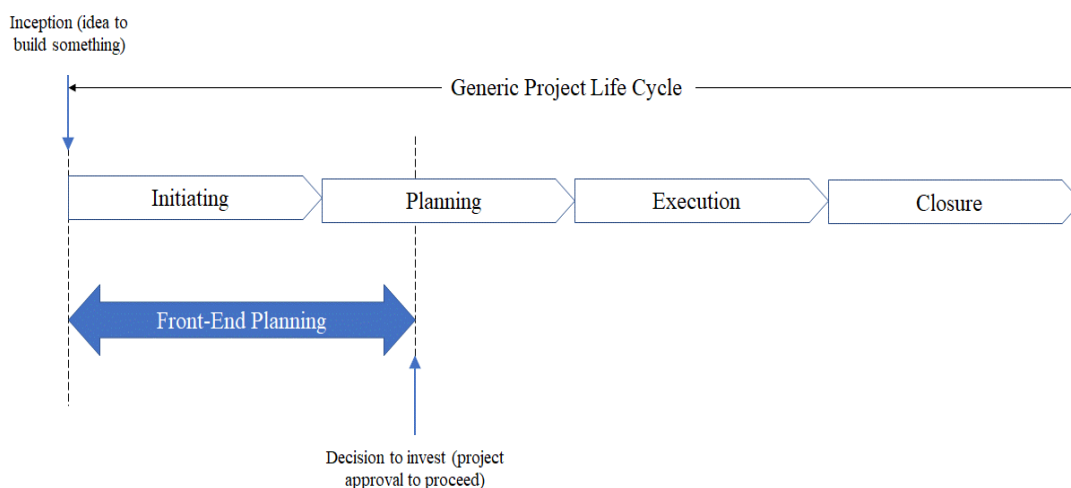


Figure 3: Position of front-end planning in a project life cycle (Researchers’ work, 2018)

It also can be highlighted that the main difference between project planning and FEP is that project planning lasts longer while FEP is only up to the stage of making a decision to invest. The major outcome of FEP is a Final Investment Decision so that the project does not waste much resources for planning and executing the wrong project. FEP is also known as the phase when the consequences of most decisions are at the highest while the amount of available information is at the lowest (Williams & Samset, 2010). The output of this phase is a blueprint that will be used as input for the next phases (Ceelen, 2014). It becomes the project manager's and team's responsibility to ensure that the right output is produced during this stage (Gibson *et al.*, 2006). Table 3 presents a comparison of project planning and FEP.

Table 3: Comparison of project planning and front-end planning (Researchers' work, 2018)

Element	Project planning	Front-end planning
Characteristic	Second phase of project life cycle	Initiation phase and part of planning phase
Engagement period	From the end of initiation phase up to the beginning of execution phase	From the initiation phase up to a decision to proceed the project is concluded
Major output	Project plans	Final decision of project investment
Focus	Planning to prepare	Planning to decide
Significance	Important to prepare for the next project phase, i.e. the execution phase	Important to restrict the project from wasting time, money and other resources in doing the wrong project

As a research topic, FEP is also known with many acronyms. Before 1994, the term 'pre-project planning' was used by CII. In short, pre-project planning is a construction industry term that describes the activities after idea creation and end at detailed design (Furman, 1999). Front-End Planning is then used to replace the previous term. The World Bank (1996) used the term of "quality at-entry" to indicate this stage which includes the project identification, preparation, and appraisal process. It includes the concept identification and selection but not detailed planning stages (Williams & Samset, 2010). In the New Product Development (NPD) term, this stage is known as the fuzzy front-end (Iluz & Shtub, 2015; Kim & Wilemon, 2002; Nobelius & Trygg, 2002). It starts with the initial search for new possibilities and ends when the organization approves the formal development of the concept to begin (Iluz & Shtub, 2015). Another popular acronym of FEP is front-end loading (used especially in industrial projects) which defined by Jergeas (2008) as the period starts from initiation up to the point of official project endorsement when the 'Appropriation for Expenditure' for full budget funding occurs. Other acronyms include schematic design/design development (used especially in building projects), advance planning (used especially in infrastructure projects), conceptual planning, feasibility analysis, programming design, and early project planning. All this refers to the same term of the front-end planning phase that starts with a conceived idea and ends with the decision to finance the project (Williams & Samset, 2010).

The Significance of Front-End Planning

A good planning is crucial and hence FEP can be used to ensure project success (Hwang & Ho, 2012; Oh, Naderpajouh, Hastak, & Gokhale, 2016). Many authors has indicated that successful execution of FEP will result in better project performance (Gibson & Hamilton, 1994; Griffith & Gibson, 1995; Griffith, Gibson, Hamilton, Tortora, & Wilson, 1999; Safa, Haas, Hipel, & Gray, 2013) and thus enhance the likelihood for overall project success (Oh *et al.*, 2016; Yun,

Suk, Dai & Mulva, 2012). For example, Menches, Hanna, Nordheim and Russel (2008) conducted a quantitative research on the impact of FEP to the overall project performance and found that projects with better planning produce better performance. In a similar study, Schoenhardt, Pardais and Marino (2014) found seven common root causes for project failure where failure to complete FEP is considered the main factor that gives 60-85% impact on budget variance. In other words, inadequate planning during FEP stage may result in poor project execution (Jergeas, 2008; Oh *et al.*, 2016). Insufficient planning of FEP process will directly result in: (1) unclear project scope definition, (2) unstable project team organization, (3) incomplete project requirements, (4) ambiguous roles and responsibilities within the project organization, and (5) incomplete project plans. If this occurs, certainly it will have an impact on the project performance which results in: (1) doing the wrong project, (2) level of rework required increase, (3) delays in project execution, (4) project cost overrun, (5) loss of profits, and (6) stakeholders' dissatisfaction (see Faniran, Love & Smith, 2000; Williams & Samsets, 2010).

Therefore, for megaprojects such as large infrastructure or industrial projects, it is very important to spend sufficient resources on the FEP phase. It is strongly justified considering the high level of project complexity and risk while the costs associated with scope changes are very high (Haji-Kazemi, Andersen, & Krane, 2013; Jergeas, 2008). The main purpose of investing more resources in FEP is to increase the project success rate (George, Bell & Back, 2008; Hanna & Skiffington, 2010; Hwang & Ho, 2012; Liu, Rasdorf, Hummer, Hollar, & Parikh, 2013; Oh *et al.*, 2016). Hence, the importance to 'do the right project' becomes increasingly important (Gibson *et al.*, 2006; Williams & Samset, 2010). With proper FEP, project team can identify project risks early in the project planning phases (Bosfield, 2012). Besides identifying risks, FEP is also a phase where project values are developed (Edkins *et al.*, 2013). Chapman and Ward (2011) proposed the use of gate reviews to address project values and risks under uncertain environment. Forgues and Koskela (2009) concluded that the goal of FEP is to identify project strategies, unify project objectives, describe team roles and responsibilities, and enhance project communication.

Front-End Planning Organisation Management

To extend the project's success factor, it is necessary to establish a baseline definition of organization management (Kraft & Chinowsky, 2003) which defined as 'the application of knowledge, skills, tools, and techniques to organizational and project activities to achieve the aims of an organization through projects' (PMI, 2003). Although it is a prerequisite for effective management system (Tiller, 2012), there is no previous research related to the organization management of front-end planning phase. According to Steiner (1979), an organization management comprises two elements, i.e. strategic management and operational management. In a similar way, there are two elements of FEP organization management proposed in this study, i.e. the policy level management and the technical level management. The policy level management is a strategic management that is fulfilled at the top of an organization structure and has the power to influence how strategic decisions are made. In this case, strategic decisions are mainly related to the decisions that can affect the viability of a project. Technical level management is an operational management that supports policy level management by providing them with knowledge and information needed in making strategic decisions. When it is done effectively, it contributes to the success of FEP organization through the development of a competitive advantage. Both management levels are thus a vital part of successful FEP implementation.

The policy level management consists of the employer and the project manager. The employer is the project sponsor. It has the power to influence decision-making and responsible for ensuring a successful project (Kloppenborg, Tesch & Manolis, 2011). The project manager is the person assigned by the employer to lead the project team and in charge of the project. He/she has the responsibility to set up the environment for project success. Together with the employer, the project manager must establish effective communication of the project team (Sewchurran & Barron, 2008).

At the technical level management, FEP project team has two vital elements, i.e. strategic planning team and technical working group. The strategic planning team is a group of professionals (usually senior members and experts) that helps strategic management in planning and developing project definitions and alternatives. It has a major influence in delivering project objectives and generating strategic options for employer and project manager. Meanwhile, a technical working group is a group of professionals whose has a particular technical expertise that will be used to provide technical advice. Together with strategic planning team, they support the policy level management in making the right project decisions. Figure 4 below illustrates the relationship of organization management elements during FEP phase for small projects but may be modified for large-scale construction or infrastructure projects.

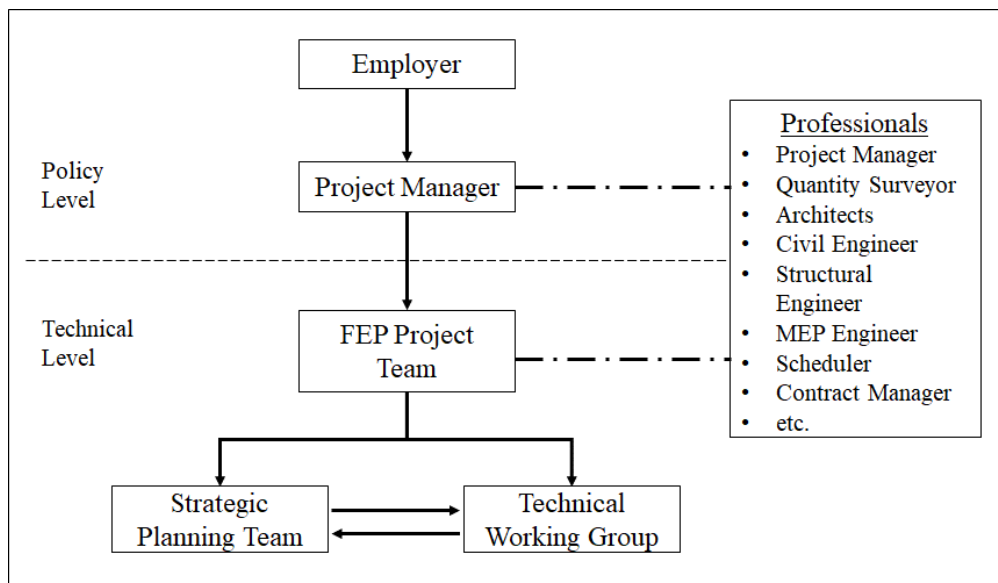


Figure 4: Front-end planning organization (Researchers' work, 2018)

Front-End Planning Phases

In order to provide a better control, projects are divided into phases. A phase has a definite beginning and end point and is characterized by typical activities and processes. Similarly, various efforts have been made to identify FEP phases. Furman (1999) tried to develop a set of logic flow diagram (LFD) of FEP processes for building projects. He proposed three LFDs to be used with the PDRI for Building Projects. These three are the section diagram, the category diagram, and the elements diagram. They are used to explain the logic of FEP process by showing functional relationships of the activities.

Meanwhile, according to CII (2014), FEP has three main phases as shown in Figure 5. The key point from this figure is that FEP process starts from the project feasibility phase and completed during detailed scope phase. Although this model is often referred to, it does not describe the overall FEP key features which includes the decision-making process. Thus, there is a need for more detailed model by considering FEP activities starting from the project initiation up to making decision to fund.

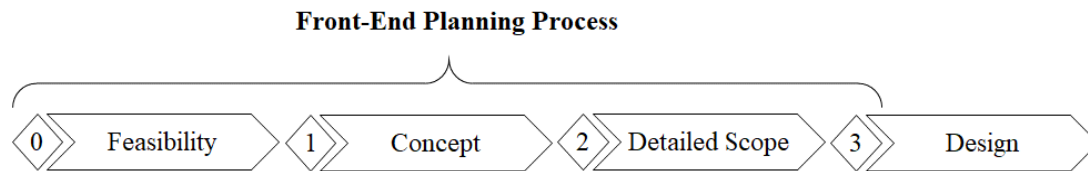


Figure 5: Front-end planning phases (Adopted from CII, 2014)

Based on the CII model coupled with the FEP key characteristics identified previously, FEP can be grouped into six key phases as shown in Figure 6. There is a decision gate (DG) at the end of each phase. A decision gate (also known as phase-gate or stage-gate) is needed to ensure that a process or idea has met the project objectives. In other words, it is a quality assessment of a process or an idea. It has one of five possible results: go, kill, hold, recycle, or conditional go (Cooper & Edgett, 2012).

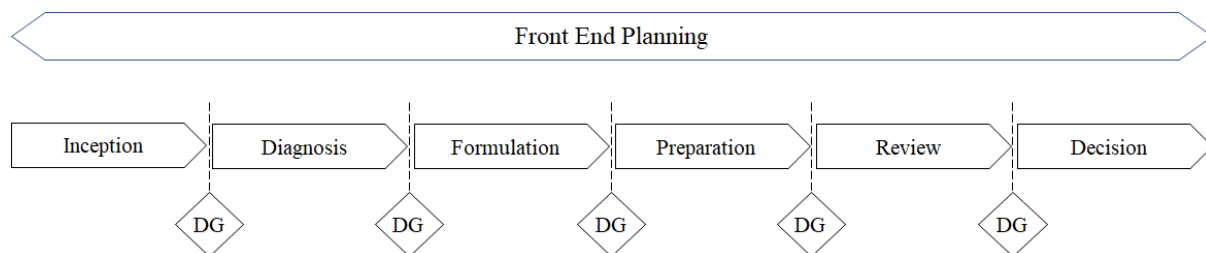


Figure 6: Proposed front-end planning phases (Researchers' work, 2018)

For all projects, FEP starts with the idea and employer's desire to create something (Newell & Grashina, 2004) which is called inception phase. Generating the idea is the first activity that the employer does. Later, the employer must decide whether he/she wants to realize his/her idea or not. If he/she decides to continue, the next phase is diagnosis. At this phase, the employer (and maybe assisted by some professionals) will analyze the current situation and assess whether there is indeed a need for this project. This is important because without proper diagnosis, the employer may end up with the wrong conclusion that the planned project is needed.

Next is the formulation phase, which is defined as a process of formulating all the initial preparation needed to obtain maximum benefits of the project. It requires the employer to establish an organization to perform FEP process. Organizing for FEP starts with project team selection. It is important to select the people who have adequate subject matter knowledge and expertise at the FEP stage so that FEP can serve effectively for the next stages (Oh *et al.*, 2016). This team will be managed by a project manager and have the responsibility to develop a project charter. A project charter is the first document created and serves as the basis for the commencement of a project (Newell & Grashina, 2004). It will be approved by the employer and any delay in getting the approval means that the cost of work that is done on the project is

lost (Newell & Grashina, 2004). In developing the project charter, the FEP team may have to do some site investigation, analyzing possible technologies, preparing preliminary scopes, and evaluating alternatives.

The preparation phase follows where project team prepares FEP plans including planning targets, identifying project risks, defining detailed project scope, and developing preliminary designs. This phase is very important since a poorly defined project scope is one of the main reasons for project failure. If the scope of project is poorly defined, its resources, time and cost will be understated (Newell & Grashina, 2004). Zwikael (2009) found that activity definition is the most critical planning process which significantly influencing project success. It provides the greatest potential for reducing budget and time variability (Gao, Smith & Minchin, 2002). Project scope definition is the process by which projects are defined and prepared for execution (Wang & Gibson, 2006). Poorly defined scope elements may increase the final project costs due to the inevitable project changes which interrupt project execution, cause rework, delay project delivery, and lower productivity (O'Connor & Vickroy, 1986). At least there are three project baselines that must be prepared and developed by project team, i.e. scope baseline, cost baseline, and time baseline. Most projects will establish the scope baseline first. Early establishment of scope baseline has the advantage of giving the team a means of tracking changes early in the project (Newell & Grashina, 2004). Hence, there is a lot of research focus on project scope definition. Once the project scope is defined and approved, project team will then develop the preliminary designs to be used for the next stage, i.e. front-end engineering design (FEED). It is performed during detailed scope and consists fundamental documents such as the engineering plans, outputs, and deliverables for the chosen scope of work (Yussef, Asmar, Ramsey & Gibson, 2017). The importance of this phase is being increasingly recognized (Samset & Volden, 2016).

The preparation phase is followed by the review phase. This is a phase where the decision makers (employer and project manager) make a review and justification whether what has been done in the previous stages is good or requires some adjustments. This is done with a project justification which defined as a description of ensuring something is to be right or reasonable. It will consider all of the benefits and costs that are associated with the project, early in the project before moving to next phase (Newell & Grashina, 2004). If there is a mistake, project team needs to make some adjustments.

The final phase of FEP is making the decision whether a project is approved to be developed to the next project phase or not. At this phase, decision makers need to make judgments. Williams and Samset (2010) argue that at this stage the decision consequences are at the highest level while the information available is minimum. Without effective FEP, it is common to find that decisions made based on intuition and less on model-based analysis. It has been argued that in reality, decisions are affected more by politic than by rational analysis. That is why decision-making in construction is complex and unpredictable. In an ideal technocratic model decision-making, this would not be happened since decision and analysis follow in a logical and sequential order (Samset, Berg & Klakegg, 2006). In 2013, Nada examined factors associated with early decisions relevant to investment that are made before project funding approval. Early decision-making often has an enduring impact during the project advancement and lifespan.

These six phases are summarized in Table 4, which describes the associated FEP activities with its correspondent questions for each specific phase that serve as a decision gate point.

Table 4: Front-end planning phases and activities (Researchers' work, 2018)

FEP PHASES		FEP ACTIVITIES	QUESTIONS
Prefeasibility	Inception	Searching new possibilities and generating idea to build something	Where do we stand today?
	Diagnosis	Analyzing the current situation in construction sector and its environment and assessing needs	Do we need this project?
Feasibility	Formulation	Organizing project team, developing project charter, analyzing technology, evaluating sites, preparing conceptual scopes, analyzing alternatives	What should we do first? Which directions should we go? Which technology should we adopt?
Basic engineering	Preparation	Planning targets, identifying project risks, defining detailed project scope, developing preliminary designs, etc.	How (at what pace/ what cost/ which specific measures/ etc.) shall we get there?
	Review	Reviewing and justifying the outcomes from previous phases	Are we moving to the right direction? Is there any adjustment needed?
Decision-making	Decision	Making decision whether to proceed with/ to invest in the project or not, approving project execution plans	Are we making the right decision?

Front-End Planning Implementation and Practices

The FEP process implementation differs throughout the construction industry (Yun et al., 2012). Several tools have been developed to improve the effectiveness of FEP including project benchmarking, alignment thermometer, TQM, and PDRI (Hamilton & Gibson, 1996; Sherif & Price, 1999). The correlation between project performance and PDRI score has been extensively explored. Wang (2002) has established a connection between enhanced project performances and well-defined project scope. Zwikael and Globerson (2006) stated that benchmarking is an efficient technique and has been frequently used in the project management environment. CII's Benchmarking and Metrics (BM&M) has been introduced since 1996 (Hamilton & Gibson, 1996). It collects resources as its inputs and PDRI as the outputs related to FEP process (Yun *et al.*, 2012).

Later in 2006, CII developed the FEP Toolkit which served as a 'one stop shop' for the vast amount of CII FEP knowledge and tools. In 2009, CII updated the FEP Toolkit to clarify methods for using the available FEP tools. In 2010, CII developed the third installment of the PDRI tool, called the Project Definition Rating Index-Infrastructure Projects. A significant difference was found between each PDRI tools regarding average schedule, cost and change order performance (Bingham, Gibson & Cho, 2011). In essence, PDRI is used to assess project scope (Dumont, Gibson & Fish, 1997; Cho, Furman & Gibson, 1999; Cho & Gibson, 2001; Yun *et al.*, 2012) which can analyze the risks associated with the projects (Ingram, 2009). Up to 2017, there have been five PDRI tools developed by CII, namely: RT-314A (for small infrastructure projects), RT-268 (for infrastructure projects), RT-314 (for small industrial projects), RT-113 (for industrial projects), and RT-155 (for general building projects). Previous research has been done to compare each tools one another. A comparison of PDRI tools between small and large industrial projects concluded that small industrial projects have more

pronounced renovation and revamp project considerations during FEP than large industrial projects. It also found that in small industrial projects, FEP process should be more focused on project execution and that small industrial projects are less rigorous than large industrial projects (Collins, Parrish & Gibson, 2016).

It should be noted that the PDRI alone does not ensure project success, but should be coupled with sound business planning, alignment, and good project execution (Cho & Gibson, 2001). Alignment is another important aspect of FEP practice. In 2001, Griffith and Gibson explored the important characteristics of team alignment during FEP process for industrial projects. Their research differentiates the definition of project alignment and project teamwork. Alignment is the condition where appropriate project participants are working together toward the same set of project goals. They further outlined ten critical alignment issues that contribute to project success. By addressing these issues and determining the alignment, the project team can then assess their risks. CII has identified keys to address project uncertainties including construction knowledge and expertise (Oh *et al.*, 2016).

The influence of FEP to different types of project procurement has also been studied. Recent research by Sindhu *et al.* (2017) compared the effects of FEP on conventional procurement, design-build (DB), and construction manager at risk (CMR). This study revealed that FEP has a positive relation to the success of fast track procurements (DB and CMR). The results also highlighted that project performance under DB were better than CMR.

Meanwhile, the use of early warning signals of potential problems in FEP has been studied by Haji-Kazemi *et al.* (2013). Using a case study of a Norwegian project, they conducted an analysis on the early warning signals during FEP stage and showed how a more effective decision can be made. Matthews *et al.* (2006) outlined the implications of FEP to project security by identifying six best practices: (1) front-end planning, (2) alignment, (3) design effectiveness, (4) constructability, (5) materials management, and (6) planning for start-up. They stated that FEP is the first step where project security can be deal with during the project life cycle.

Sometimes justifying that FEP is needed especially in green building projects is difficult due to barriers such as bigger project complexity, misconception of sustainability, and the perception of a higher chance of cost overrun than in conventional building projects. Comparison between green building projects and conventional building projects in relation to FEP efforts has been conducted by Kang, Kim, Son, Lee and Limsawasd (2013). They used PDRI to measure the degree of FEP efforts. Results show that there is a positive relationship between FEP and cost performance of green projects. It is even stronger than the relationship between FEP and cost performance of conventional building projects.

In addition to the above studies, research related to the implementation of FEP is still widely open to be explored. Automatisation for instance. In fact, FEPT based on electronic process has been used for construction of megaprojects. A study showed that the use of electronic FEPT increases the efficacy of FEP in megaprojects (Safa *et al.*, 2013). One of the few related studies on automated FEPT for costing and scheduling was performed by Jung in 2008. While preliminary estimate and schedule are an important part in FEP that has been widely studied, not many research projects have revealed FEPT roles in these aspects. Figure 7 summarizes previous research related to FEP implementation and practices.

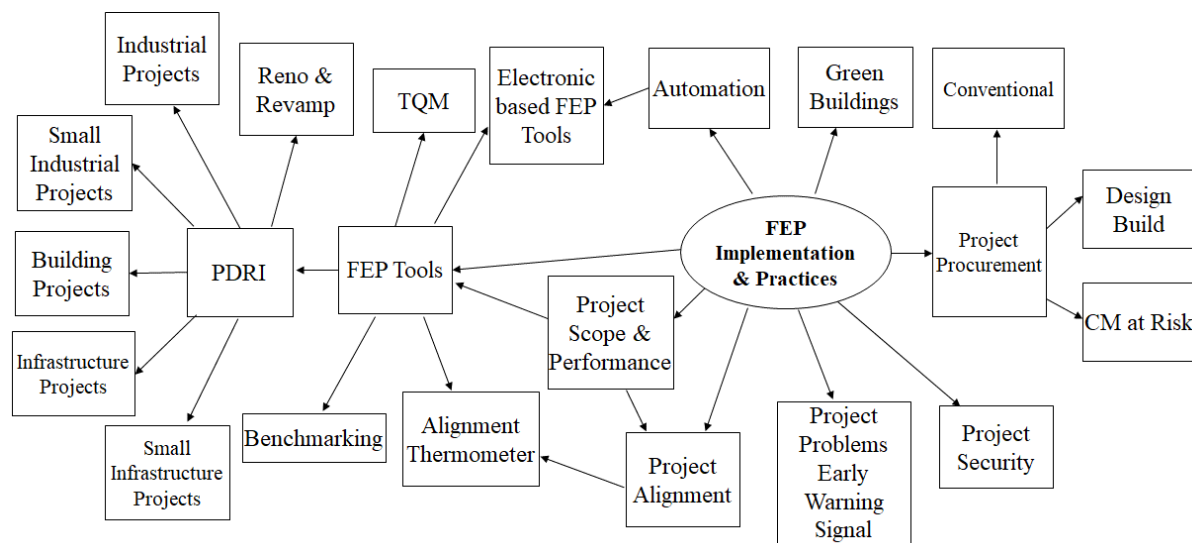


Figure 7: Previous research related to FEP implementation and practices (Researchers' work, 2018)

Challenges in Front-End Planning Implementation

Regardless of the FEP significance to project success, some practitioners still decide to proceed to the next phase without adequate FEP (Lucae, Rebentisch & Oehmen, 2014; Oh, Naderpajouh, Hastak & Gokhale, 2016). First of all, not all stakeholders agree to pay more attention to FEP (Lucae, Rebentisch & Oehmen, 2014). This is because FEP process requires resources (time, money, etc.). FEP implementation may take a long duration to be completed. A study by Safa *et al.* (2013) revealed a typical FEP duration of one to two years for a megaproject. In electronic-based FEPT, it is recommended that the project team clearly communicate the need for FEPT and other IT systems. Nobelius and Trygg (2002) found that this phase made up at least one fifth of the total project duration. Samset and Volden (2016) have identified ten paradoxes which point to two main issues i.e. FEP efficiency in terms of delays and cost overrun, and project's strategic decision in choosing the wrong project to be executed. FEP is a challenging process and the costs associated with FEP should be considered as an investment rather than an expense (Hwang & Ho, 2012; Lucae *et al.*, 2014).

Another challenge is that FEP with different circumstances will demand diverse resources to be successfully implemented (Yun *et al.*, 2012). The process of FEP as part of project planning is complex and involves many parties (Cohenca, Laufer, Shapira & Howell, 1994). Among other stakeholders, the employer has the primary role and responsibility in FEP process. One of the first step that the employer has to do is to establish the roles and responsibilities of project team members. Ambiguous roles and responsibilities during the FEP process may hinder the work of project team (George *et al.*, 2008). Since FEP process is complex, the employer may work together with other professionals who serve as the consultants or project team members. Thus, team continuity is important so that the FEP implementation process can run smoothly (Gibson, Kaczmarowski & Lore, 1995). In addition, FEP requires expertise in project planning and development. Some construction companies may lack the in-house expertise. In cases where there is no construction expertise during FEP phase, it is recommended to hire from external sources (Oh *et al.*, 2016).

While Gibson *et al.* (1995) and CII (2014) suggested that FEP should be standardized, Nobelius and Trygg (2002) encourage professionals and academics to stop chasing an ideal FEP process model of a product development project but pay more attention to managerial flexibility in this phase. Their study suggested the need for early and proper FEP, which then can be analyzed and shared with the project team. The project team should be careful enough not to rely on compliance and checkboxes only (Lucae *et al.*, 2014). There have been many tools developed but the implementation of FEP process will vary between one project to another (Gibson *et al.*, 2006). Lack of knowledge on FEP tools and the existence of other processes or planning methods may hinder the effectiveness of FEP to project success (Gibson & Bosfield, 2012). Without proper knowledge and expertise, poor risk identification and scope definition would definitely happen (George *et al.*, 2008).

Table 5: Challenges in FEP implementation (Researchers' work, 2018)

Challenges	Sources
Internal Challenges	
Lack of knowledge on FEP tools and processes	Gibson & Bosfield (2012)
Long duration of FEP	Nobelius & Trygg (2002); Safa <i>et al.</i> (2013)
Resources consideration (time, money, people, etc.)	Cohenca <i>et al.</i> (1994); George <i>et al.</i> (2008); Gibson & Bosfield (2012); Hwang & Ho (2012); Lucae <i>et al.</i> (2014); Samset & Volden (2016)
Lack of expertise and trained facilitators and participants	Gibson & Bosfield (2012); Oh <i>et al.</i> (2016)
Lack of management commitment	Gibson & Bosfield (2012); Lucae <i>et al.</i> (2014)
Poor scope definition	George <i>et al.</i> (2008)
Poor risk identification and mitigation	George <i>et al.</i> (2008)
Ambiguous roles and responsibilities during FEP	George <i>et al.</i> (2008)
Think of it as a one-time effort	Cohenca <i>et al.</i> (1994); Gibson <i>et al.</i> (2006); Lucae <i>et al.</i> (2014)
Complete reliance on FEP Tools	Lucae <i>et al.</i> (2014)
FEP project team continuity	Gibson <i>et al.</i> (1995)
Lack of flexibility	Nobelius & Trygg (2002); Hong <i>et al.</i> (2004)
Reluctance to learn new things, in this case FEP processes	<i>proposed in this work</i>
Reluctance to change from the usual practices	<i>proposed in this work</i>
External Challenges	
The existence of other processes or planning methods	Gibson & Bosfield (2012)
Ineffective external communication	George <i>et al.</i> (2008)
Varies in circumstances require diverse resources	Yun <i>et al.</i> (2012)
Assumption that it may not be suitable due to different conditions	<i>proposed in this work</i>
Difficulties to be implemented in concurrent/ fast-track projects	<i>proposed in this work</i>

While planning is a continuous process, another challenge identified is to think of planning as a one-time effort (Cohenca *et al.*, 1994; Lucae *et al.*, 2014). In fact, FEP is a pivotal process that must constantly be conducted on each project (Gibson *et al.*, 2006). It has to be updated regularly so that changes can be accommodated quickly. On the other hand, project goals should not be either too vague or too restrictive. They should be usable, acceptable, and flexible (Hong, Nahm & Doll, 2004; Nobelius & Trygg, 2002).

Although it has been widely discussed, team alignment still remains a challenge in FEP. There are difficulties to create a solid team. It requires commitment, expertise, and experience so that a project team can work together towards the project goals. It needs a reliable project manager to lead this team. With many participants involved, project manager must be able to understand the different mental modes of each team member. Communication must be developed internally and externally. Ineffective external communication has been proven to be a challenge in FEP implementation as well (George *et al.*, 2008).

Another challenge in FEP implementation that may not have been discussed in previous research is considered FEP as a foreign product. This will result in three assumptions, i.e. (1) since it is a foreign product, it may not be suitable to be implemented here due to different conditions; (2) reluctance to learn FEP processes; and (3) reluctance to change from the usual practices. Lastly, the FEP implementation will also face some difficulties when concurrent and fast-track projects are being implemented where the planning and execution phases of the work may overlap each other.

Realizing the above challenges, FEP team may establish efforts to ensure the effective FEP implementation. In short, the principles of successful FEP implementation are planning standardization, owner-driven process, well defined scope, a comprehensive understanding of project requirements and goals, detailed design, and a corporate process that supports planning goals (CII, 2014).

Directions for Future Research

The importance of FEP process is being increasingly recognized. However, it is still underrepresented in the literature (Samset & Volden, 2015). In addition, research on FEP adoption status in various countries have not been widely studied. In developing countries like China and Indonesia where infrastructure development is growing rapidly, FEP related research will be of great value in the long term. Thus, research related to FEP implementation in these developing countries has the potential to be investigated and offer significant benefits.

Future research can also be done by looking at how FEP is being implemented in various construction organizations by observing possible contradictions between theory and practice (Motta *et al.*, 2014). Gibson *et al.* (1995) believe that FEP can be standardized. Much efforts have been made to standardize FEP process mainly related to Project Definition Rating Index (PDRI) application for various types of project. However, there are still many areas of the FEP process that can be researched and developed, such as partnering system, constructability, and early dispute mechanism in FEP implementation.

Another future research recommendation is related to decision-making process during FEP. As has been explained earlier, FEP final phase is the decision-making phase which will result in a final investment decision and project approval. The impact of this phase is significant while in reality there have been not many studies conducted in this area (Haji-Kazemi *et al.*, 2013;

Ceelen, 2014). In 2012, Hwang and Ho have stated that some professionals in this industry do not appreciate the significance of project planning. Thus, the lack of professional knowledge in FEP can be a worthy challenge to be researched.

CONCLUSION

Failing to plan means planning to fail (Avwontom, 2016). Eventually, the responsibility for planning lies with the project manager who should ensure that planning have been conducted properly and to satisfy all key stakeholders of the project (Zwikael & Globerson, 2006). Furthermore, project manager must be able to make a decision on time so that FEP implementation becomes effective and efficient.

From the review study, seven categories of FEP issues were identified. It indicates that effective FEP implementation is one of the most important issues that employers and project managers must address. This paper also highlights the differences between project planning and FEP. It presents alternative FEP phases which consists of six phases with a decision gate appears at the end of each phase. Another issue identified was the FEP organization management which might be new in this study.

This paper's contribution is threefold. Firstly, it presents a consolidated synthesis of key literature on FEP in construction industry. Secondly, project managers and researchers are constantly trying to study the management of FEP in many aspects. A basic understanding of the concepts and issues related to FEP is therefore essential. This research answers this need by presenting a clear FEP position within project life cycle, providing a clear differentiation between project planning and FEP, establishing FEP organization management, developing a more generic FEP phases, and identifying some challenges and issues in FEP implementation. Lastly, since this topic as a research area will continue to grow, this paper provides some directions for future research. These directions can be used to assist in the execution of more research in this area so as to benefit the project success.

At the end, the only purpose of FEP is to define project scope and thus ensure the environment for project success. The strategic value of FEP is to obtain the highest opportunity for the project team to influence project performance as early as possible. Therefore, effective FEP implementation is required. The last 30-years' studies have provided the necessary foundation for FEP progress and development as a strategy in setting the stage for successful project execution.

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