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RISK ASSESSMENT THROUGH CONSTRUCTION SEQUENCE ANALYSIS FOR PLANT CONSTRUCTION PROJECTS

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Although South Korean construction companies have significantly increased their share in the international construction market, the work scope of their projects has been limited to detail design and construction, instead of expanding their market to the earlier phases of project execution. South Korean companies should also expand their capabilities to project management consultancy (PMC), enabling planning and scheduling knowledge to handle various risks associated with each work package. This research involved developing a Unit Activity Sequence Model (USAM) for industrial plant construction projects to minimize project risks. A Standard Sequence Logic Unit was set up to establish the initial scheduling phase of plant projects, and to understand objectively construction flows and the association between construction events, etc. Previous research has a scope that is very limited to specific plants, and it is currently unsatisfactory to understand the flow of overall plant construction. This research is different from other studies busing USAM per work package in the initial planning process, in order to help determine the overall flow. It is based on various references and extensive opinions collected from the schedule management experts as a reason for the lack of case studies. Thus, more research and process-related data collection needs to be added from the experts in various research companies.

Keywords: Plant project management, Plant risk Management, Planning, Scheduling, Activity sequence, South Korean construction industry.

1 INTRODUCTION

South Korean construction companies have significantly increased their market share in the international construction industry in recent years. Total revenue was 65 billion USD in 2011, primarily due to the increased volume of work awarded in the Middle East. For most industrial construction projects, the management process requires a detailed level of coordination amongst various trades when planned. However, this coordination is not always simple, because most construction projects work under independent contracts with the owner. South Korean construction firms have difficulty responding to owners' requirements to coordinate various trades when they work in the international market, primarily because most of those construction projects are complex and large in scale. Furthermore, there is a higher level of risk. This research involves assessing those risks.

2 RESEARCH BACKGROUND

South Korean construction firms have worked in the international construction market for almost a half a century in 138 countries. They have executed approximately 9,000 contracts, with a total revenue of over 500 million USD. Contract amounts have been significantly upward after 2004 (International Construction Information Service 2013), indicating a very promising future. However, the South Korean firms have struggled to maintain positive revenue when executing these contracts. In other words, they have suffered from many issues dealing with various clients and contractors in the market despite being quite successful in the South Korean market.

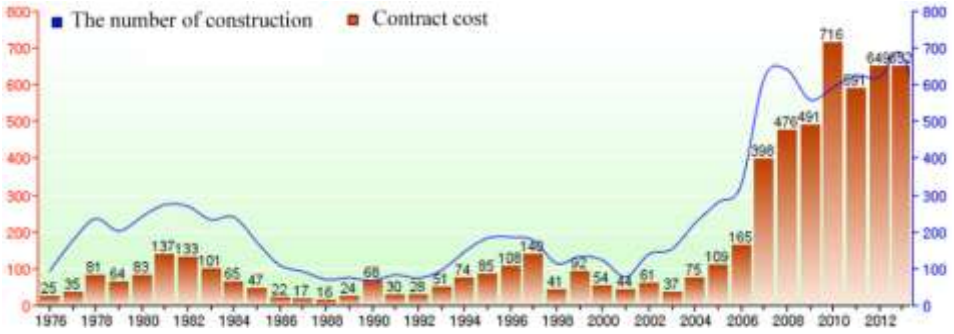

Figure 1. Cost of the project.

The scope of work South Korean firms have mostly undertaken includes basic civil and structural engineering, basic procurement, and construction. However, this scope of work is usually less profitable than a front-end-engineering-design (FEED) scope. Also, the competition in those areas has gotten more intense as more third-world countries enter the market. Figure 2 represents the structure of project execution (Ministry of Land, Infrastructure and Transport 2006).

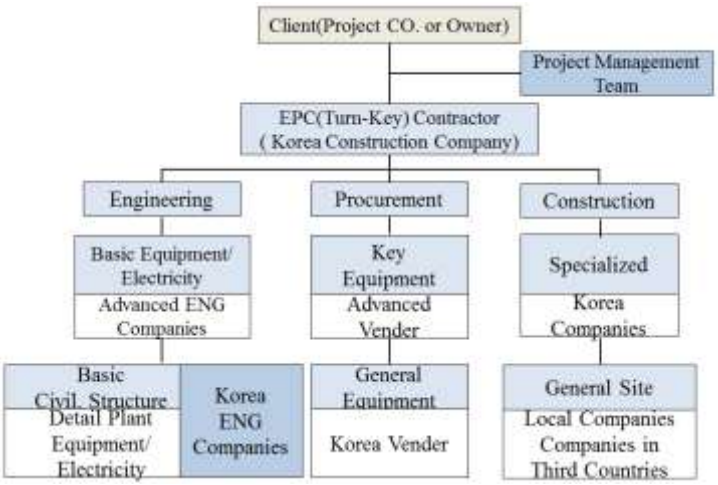

Figure 2. Structure of the project.

Most advanced technologies are dominated by several countries. They own licenses for technology and key process equipment. Therefore it is important for South Korean firms to focus more on project management capability. Project management begins with a high level of planning skills (Son et al. 2007). Researchers developed an activity sequence model to respond to the risks associated mainly with the planning and scheduling of construction projects. There are three steps for development: schedule management, risk management, and project management.

3 RESEARCH SCOPE AND METHOD

This study identifies the overall flow of the initial scheduling construction, focusing on the process management for industrial plant project managements. The field to be studied is the development of the critical path sequence in the plant and construction stages. Results will suggest the EPC (Engineering, Procurement, and Construction) critical path sequence for the main process plant construction phase, in order to establish objective and systematic process planning.

The research method is to collect and analyze case studies in the EPC process and the process management through previous research, seminars, and interviews with experts specializing in process management at domestic plant construction companies. This would identify the main process activities of plant projects. Next, this study puts emphasis on standard sequence logic by analyzing the relationship with each critical path activity. A Unit Activity Sequence Model (USAM) has been developed based on the overall flow of construction, depending on each work package.

4 LITERATURE REVIEW

4.1 Concepts and Characteristics of Plant Construction Project Process Management

The focus of any plant construction's project management is to complete the project in a timely manner at minimal cost. This is accomplished by managing it with the most effective arrangement and operation of the basic resources of construction; manpower, capital, materials, and equipment etc. It is the overall process of construction management as a means of collecting construction plans, and making effective use of resources for successful implement of the project (Ministry of Land, Infrastructure and Transport 2007). Plant projects are complex and highly specialized and likely to increase in scale. They are in a technology-intensive industry requiring knowledge services—not only in terms of manufacturing technology, but also consultation and finance. It requires more subdivided and developed business management plants through industrial engineers (Lee et al. 2008).

Plant projects are intricate due to having various processes, and should be completely constructed with basic resources in short-term. Therefore, successful projects must establish efficient and specialized process management systems via appropriate distribution and management of resources and cost.

5 THE DEVELOPMENT OF SEQUENCE ANALYSIS MODELS FOR MAIN PLANT PROCESSES

5.1 Standard Sequence Logic

Plant projects have a certain degree of work interference between the detailed processes. However, it is not easy to measure this impact objectively during the overall period, or to determine the overall period in the beginning of the process planning stages with the existing methods of process management (Song 2009). The purpose of developing the plant project USAM is not only to comprehend the flow of the entire construction project during the initial process planning stage, but also to develop a progress schedule effectively—with the overall schedules including design phase, purchasing, and procurement process. Thus, understanding the flow of construction and the function between works leads to efficient schedule management.

With the help of interviews with domestic plant process management experts and case studies, main activities can be derived from the 16 steps of design phase, the 20 steps of the major construction phase activities. The Standard Sequence Logic presents the working relationship for each activity of design and construction phases.

Precedence relationships of the design phase are shown in Figure 3. The predecessor in the design stage consists of the main activities, and the trailing work is composed of purchasing, procurement, and construction. For example, in Figure 4, the Pipe Rack/Equipment foundation drawing process is a task to design the foundation of the structure for the pipe and the equipment installation. The predecessors are the Topographic Survey and Soil Investigation, Soil Investigation Report, and Pipe Rack/ Equipment Location Plan. After geotechnical soil investigation, the next procedures are purchasing and procurement of Concrete/Anchor Bolt Template and Pipe/Equipment Structure, and LLI Equipment to create the basis for a process.

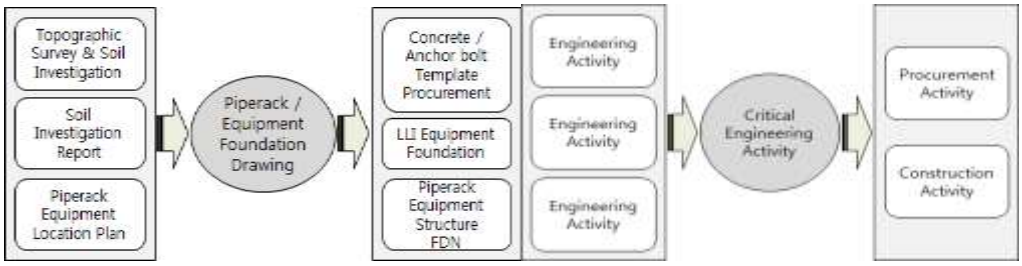

Figure 3. Concept of Engineering Activity. Figure 4. Pipe Rack/Equipment FDN drawing.

5.2 Unit Activity Sequence Model (USAM)

The USAM for plant project is derived from schematized main activities and precedence relationships of tasks presented as a conclusion. The overall process flow is organized by work packages, such as Civil, Steel Structure, Equipment, Piping, Building work, Electrical, Instrument, etc. This study argues that the pre-commissioning stage is considered as the post-process of construction process, examining the function of the complete construction results.

USAM is not confined to a particular plant model. It can be applied to a variety of plants by establishing work-unit activity sequences by analyzing the precedence in each

activity selected as core operations of each process. It is also intended to facilitate understanding of the entire EPC schedule process objectively, including engineering, purchasing, and procurement phases. It clearly demonstrates that plant process planners are able to develop the process schedules for USAM projects in early stages of project process planning. It also enables us to reach quick and objective understandings including the stage of the design, purchasing, and procurement phases for the entire EPC process.

In addition, USAM is applicable to all phases of plant projects, not only certain common projects. This understanding of the relationships between the procedures of main activities can be used to collect basic standard data for various plant projects during the initial project planning.

6 CONCLUSIONS

Standardized models are needed for further development on multiple levels: front-end-engineering design (FEED), general design, purchasing and procurement, construction, and maintenance. This is because the plant project needs enormous resource coordination in construction for more efficient and systematic plant management. It is equal to advanced countries in terms of the detail design and construction, at a time when South Korea's source technology development, basic design, and business management sector do not match those of advanced countries. Hence, more focus on schedule managements amongst project management is required to overcome the difference in the technical skills compared to advanced companies.

In this study, Standard Sequence Logic Unit was set up to establish the initial scheduling phase for plant projects, and to understand objectively the construction flow and the association between construction events, etc. The USAM was geared to this based on previous research. However, the research scope has been hitherto limited to specific plants, and is currently at an unsatisfactory level to understand the flow of the overall plant construction. On the other hand, this research is different from other studies by using USAM per work package in the initial planning process to help determine the overall flow. Also, USAM can be utilized for various types of plant project as a sample study in the early stage.

This study was based on various references and opinions collected from schedule management experts to make up for the current shortfall in case studies. Thus, more research and process-related data collection is necessary. Research is still being carried out on risk analysis and post-task risks arising from the interface of task and path. More research is needed to enhance the degree of the completion through application and verification.

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