

**P6-6****Fundamental Investigation of Knowledge Management System for a Plant**

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**ABSTRACT:** Gas & Oil plant construction projects are increasing recently all over oil-producing countries. An EPC (Engineering, Procurement and Construction) company, which participates in the plant projects, should possess pertinent engineering licenses and EPC management skills to create high added-value. Nonetheless, there exist various risks involved in the EPC life cycle process due to such characteristics of construction projects as long duration of construction time and complicated processes along with the procured goods or services subjected to various logistics. The objective of this paper is to analyze the overall EPC life cycle for proper process and to examine various information and document. Additionally, the principal data for the analysis of the EPC process are derived from personal interviews with experts and specialty contractors of the plant projects. The results of this study would be widely used as a guide for efficient and effective management of overseas gas plant projects.

*Keywords: LNG Plant, Process, Life-cycle (EPC), Knowledge-Information Management*

## 1. INTRODUCTION

### 1.1 Research Background and Purpose

New purchasing orders in gas and oil plant industry are continuously increasing, especially, in the Middle East region despite the apprehension for current income deficit stemming from skyrocketing international oil price and raw materials price hike. This decrease in business investment stemming from world economy decline has turned to be the driving force for promoting the gas plant project from the perspectives of securing long-term and stable income and economic diversity.

Gas and oil plants require various license management and technologies for the manufacturing and handling processes. Additionally, the efficiency of engineering, procurement, construction, pilot operation and business process management determines the success or failure of the business. Moreover, the market for the original technology for the generation of high added-value in the planning and basic engineering design is dominated by a few leading construction companies, and it is expected for domestic companies to join their ranks would be difficult.

Then, the efficiency of the business conducted by domestic companies and their possessed technology should be enhanced in order to strengthen their competitive power. Many experts pointed out to focus on the improvement of the life cycle process and efficiency management for this end purpose.

This study analyzed the life cycle process business process and the relevant knowledge management method

for the development of efficient knowledge management method in the plant construction industry. The result of this research will certainly assist the overseas plant project managers in the development of knowledge information management system.

### 1.2 Research Method and Scope

LNG (Liquefied Natural Gas) plant construction projects are increasing lately. The reason for this is the oil producing countries in the Middle East are promoting LNG projects despite its high cost based on the prospect that the oil price will not recover to its level several years ago due to the decreased demand for oil stemming from global financial crisis. This study analyzed the key factors for the development of knowledge management system for LNG plant construction projects from the perspective of EPC (Engineering, procurement, Construction) companies.

This research was conducted in the following sequence.

(1) The preliminary study for the development of knowledge management system for gas and oil plants involved domestic and overseas literature review and analysis of recent trend of domestic and overseas gas plants.

(2) The procurement data of domestic major EPC companies were collected and analyzed in order to derive the standard purchase/procurement process of overseas gas plants. Experts from five domestic major companies with excellent overseas construction business records

provided the data for the purchase/procurement process and its in-house computerized system. These data were used for the analysis of this study.

(3) IDEF0 model was used to process these collected and analyzed input and output information of the business process for the final production of necessary input and output information as well as the documentation in order to derive the major points of each business process stage systematically from management perspective.

(4) Finally, the method for the knowledge management system development is proposed.

## 2. Theoretical Review

### 2.1 Literature Review

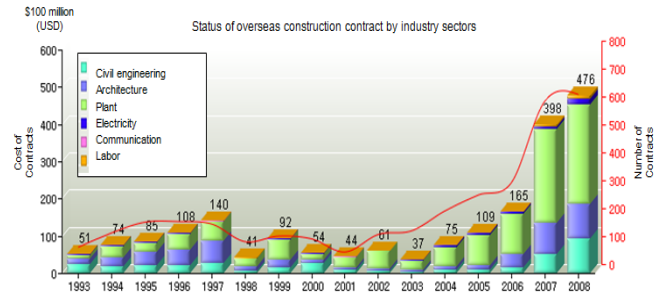
The research trend for domestic plant construction has generally focused on the current status of domestic and overseas plant construction market and its long-term development through the market prospective. First of all, there is a research on the characteristic analysis of the entrance of domestic construction companies to overseas construction market (Kim, Jin Wok, et. al. 2007), but it focused on super high-rise building rather than gas and oil plant. The majority of researches in this field are exemplified as follows. Song et. al. (2007) investigated the method for the introduction of technical management of oil and gas plant industry for sharpening the competitive edge. Lee et. al. (2006) examined mid-term and long-term technology development support and analyzed the issues for strengthening competitive power as a strategy through the analysis of current status of overseas plant construction field. In overseas, Chang et. al. (2004) studied on e-procurement for computerization of purchasing/procurement process, but it dealt with general application and implementation and not specific case of plant projects. Additionally, Puschmann et. al. (2005) introduced the concept of e-procurement systems and management of indirect goods supply chain. Thus, most of the research on the management of plant construction projects focused on the development of a management system grafting IT technology to practical construction knowledge and experience for the management of complex overseas plant projects.

### 2.2 Trend of Plant Business

Plant industry refers to facilities industry manufacturing raw material or work-in-progress material and final product for the producer. It is a knowledge-intensive industry with high economic value generation, and it can be regarded as a fusion industry between manufacturing and service industry. The purchasing order for overseas construction amounts to \$47 billion dollars (USD) as of 2008, and it has continually increased since 2003. Plant business amounts to \$26 billion dollars (USD) and accounts for 56% of the total construction purchasing order. It has shown a bullish tendency since 2007.

This plant project generally adopts EPC purchasing order method, and the technology competition and the cost for raw material and equipment determines the competitive power. Additionally, this industry is characterized by the project management and comprehensive knowledge management determining the loss and profit as well as the overall success and failure of the business.

Many owners and stakeholders in overseas are recently investing actively on PLM (Plant Life-cycle Management), and major domestic companies are also investing on this management since several years ago.



**Figure 22.** Status of overseas construction contracts (www.icak.or.kr)

This change is evident due to the fact that, although those owners and stakeholders want to apply the knowledge information extracted past work data to PLM right away during order placement, actual information and knowledge by each department are often lost and segmented, causing serious loss of time and expense. This means that, although the optimization of the business process during total life cycle is important, the management of information and knowledge acquired during each stage of the business is also important.

## 3. Management of Plant Project Knowledge

### 3.1 Trend of the relevant technology and the industry in Korea and overseas

(1) Trend of the domestic technology and the industry

Domestic 33 major companies are participating in overseas LNG plant construction. However, there is no EPC lump-sum contract with high added-value. Moreover, the level of domestic LNG plant business management technique is evaluated to be about 50% of advanced countries.

For example, a lot of information data generated during engineering design stage are not stored in EDW (Engineering Data Warehouse), causing segmentation of information between departments and individuals. This results in a waste of huge time and expense, and there has been an effort made to solve the problems through FEED (Front End Engineering Design) solution. Along with these technologies, there is a gradual demand for the management of ever-increasing data and knowledge. Thus, there is an effort made to seek ultimately the method for single source management of not only

engineering design information but also all information and knowledge at all stages of the business. In other words, it is an important task to develop a PLM method for the management of all data and information from the time of initial planning stage to the point of handing them over to the owner of the plant after its construction.

(2) Trend of Overseas Industry and Technology

Such techniques as CII and FIATECH (Fully Integrated and Automated Technology) are management techniques for LNG plant and have reached their mature stage of initiating the development of their international open standard through advanced design automation and purchase automation. CII of the USA (1996) analyzed that the largest inefficiency of plant projects occurs from engineering development stage, and it attributed the cause for it to inaccuracy of the information to be applied to the processes of purchase, construction, operation and repair/maintenance. Additionally, NIST (2002) computed the cost of inadequate interoperability of the information shared and used throughout the life cycle to be about \$15.8 billion US dollars for the case of facilities industry. CII is in the process of solving this problem through FIATECH (Fully Integrated and Automated Technology).

In other words, the aim is to develop business management foundation and core (essential) technology for the automated and fully integrated environment throughout the entire life cycle of the construction

business including planning, design, engineering, and management stages.

3.2 Case Analysis of Business Process

This study classified the life cycle as follows for the analysis of LNG plant business tasks.

- Planning : bidding, quotation, contract

- Design : basic design, detail design (real-time design)
- Purchase and Procurement
- Construction and Pilot Operation

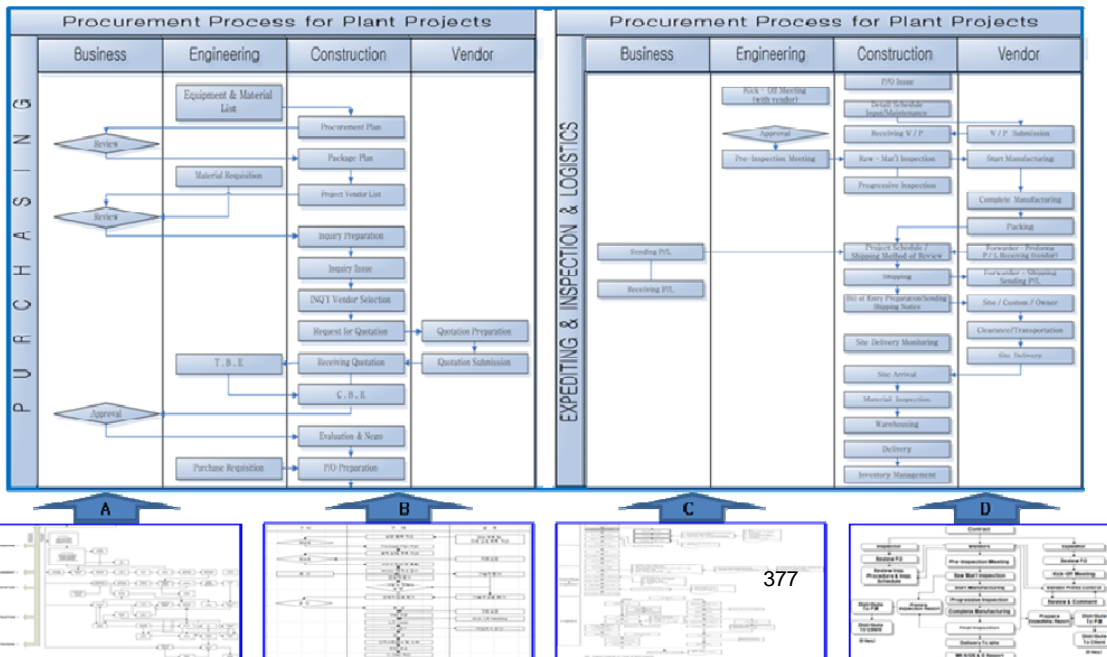
Among these categories, the purchase and procurement stage, which affect the success and failure of the business the most and account for the largest business cost, are used as an example to explain the research progress for the business process analysis. Additionally, there is a characteristic requirement for all architectural construction and, especially, for the plant. It is to procure and deliver the procured goods, i.e. all items in the equipment list and MR list (which are planned in the initial stage of the business) to the construction site pursuant to the procurement requirement of appropriate time, price, place, quantity and quality and in accordance with the field process schedule. Plant construction encompasses unique business process and handling process by the type of the product, and there exist different characteristics for the business process of each domestic leading company by the prioritized plant type. Nonetheless, most companies evenly entered into the subject of this research, i.e. gas and oil plant, and did not manifest a noticeable difference in the result of the business process analysis.

Standard purchase/procurement process refers to the process of analyzing the purchase/procurement process to derive the common tasks from the overall process and changing or adding it at will to make it fit to the

Figure 2. Derivation of purchase/procurement process for LNG plant

characteristics of the particular project.

Plant projects are mainly classified as engineering, procurement, and construction. Figure 2 illustrates the entire process map for procurement (P), and the business process are divided into the company, design, construction by pertinent tasks and the vendor (or supplier). Figure 3 shows a diagram of the ranked procurement process based on the analysis of figure 2.



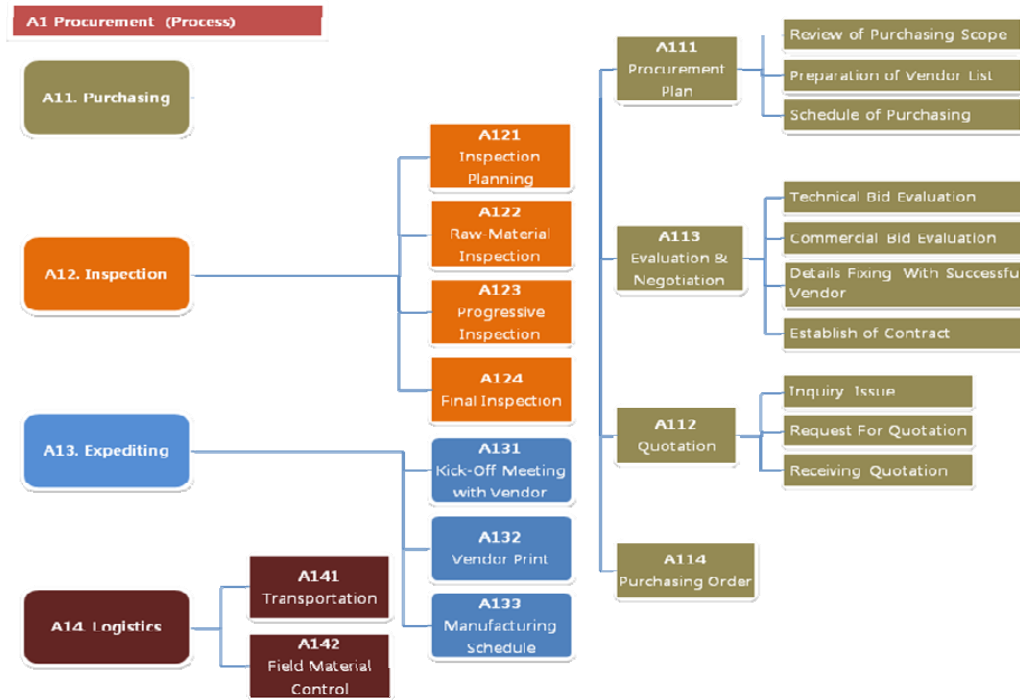
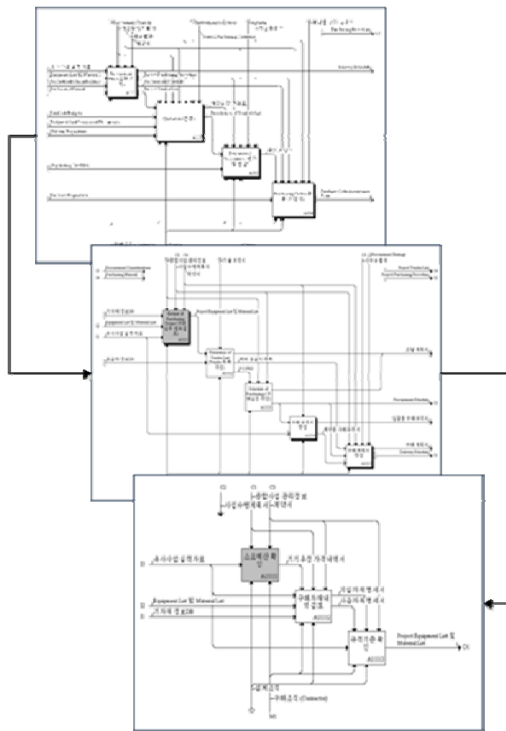


Figure 3. Diagram of ranked procurement process

3.3 Analyses of Input and Output Information and Document



Although the process map appropriate for procurement tasks makes it easier to grasp the overall flow of the business tasks, it has its shortcomings in determining the detail task information required by each important

Figure 4. An Illustration of Input and Output Information Analysis

activity (i.e. the contents of input and output documents and major management items). IDEF0 was used to list detail information of each activity to deal with this problem.

Figure 4 illustrates input and output information analysis for detail business activity as shown in figure 3. Purchasing is divided into the following four mid-level activities, and these activities are further divided into fourteen low-level activities.

- (1) Procurement Plan
- (2) Quotation
- (3) Evaluation & Negotiation
- (4) Purchasing order

Thus, the level of activities were gradually lowered (or, detailed) to analyze the knowledge and information throughout the entire life cycle.

4. Development Strategy for Knowledge Management Technology

4.1. Types of Project Management Knowledge

The types of knowledge for project management can be generally classified as it follows.

- ① Knowledge focused on Project Life Cycle)
- ② Knowledge focused on Project Management Life Cycle)
- ③ Knowledge focused on Project Management Techniques)
- ④ Knowledge focused on Construction Technology & Materials)



- Knowledge on Engineering Method and Technology
- Knowledge on Materials

the plant company connected to anywhere in the world by internet web technology. Figure 5 illustrates a simplified conceptual diagram for plant knowledge management

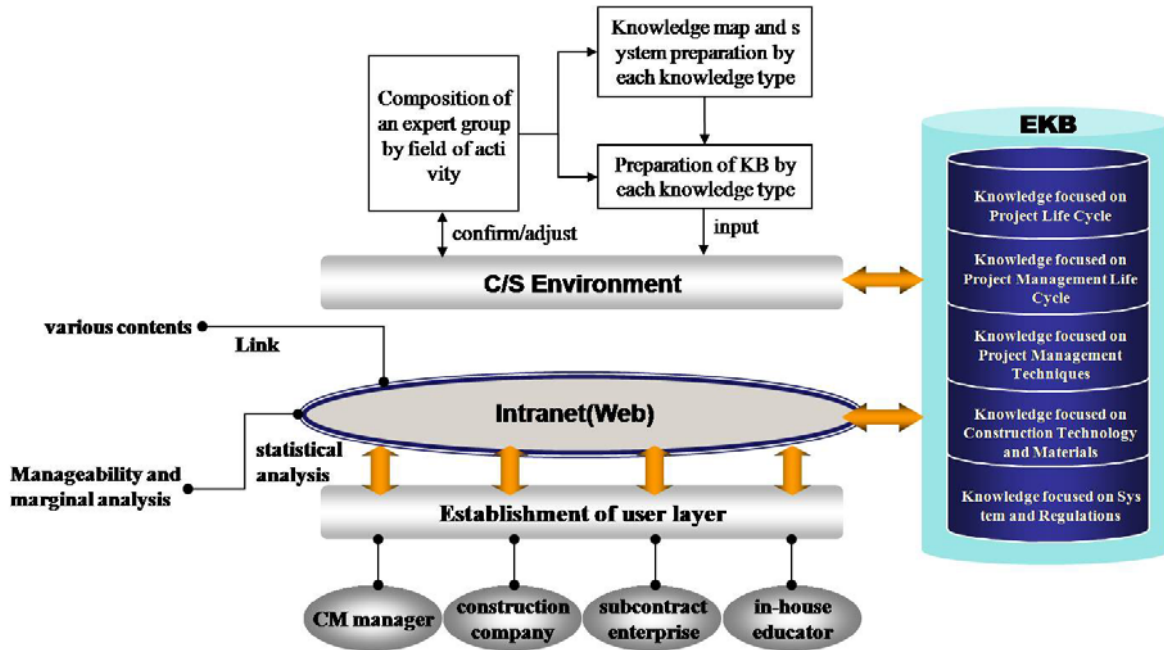


Figure 5. Concept of Plant Knowledge Management System Development

- Knowledge on Equipment Performance
  - ⑤ Knowledge focused on System and Regulations
    - Legal Knowledge
    - Knowledge on Standardization
  - ⑥ Case Knowledge: Success and Failure Cases
- Additionally, the required knowledge for the previous example of procurement management can be classified as follows.
- ① Knowledge on CM task procedure
  - ② Legal Knowledge
  - ③ Knowledge on standardization
  - ④ Knowledge on management technique
  - ⑤ Knowledge on engineering method and technology
  - ⑥ Knowledge on materials
  - ⑦ Knowledge on equipment performance
  - ⑧ Knowledge on success and failure cases

**4.2 Concept Development**

Plant construction is a complex project performed by a group of experts from various fields. Accordingly, it is important to materialize the information data based on the knowledge and experience acquired for a long time and to make it a knowledge system. The knowledge acquired throughout the life cycle is analyzed and systemized based on the business process to make it a map. Then, this data map is used for building the database by the knowledge type. The accumulated business knowledge can be used in carrying out a project through the server of

system development.

**5. CONCLUSIONS**

This study analyzed the business process of LNG plant throughout its life cycle, and the pertinent knowledge and information were identified for the development of knowledge and information management system to be used anywhere in the world easily.

Recent oil price hike has caused a temporary reduction in oil production, and gas plant management (ex. LNG) is being actively pursued. The Middle East suffered from decreased investment in energy, but its investment in gas upstream has continued. Additionally, since the quantity of not only the oil but also the gas embedded in this region is enormous, gas started to be perceived as an important resource for long-term growth of the plant.

This study aimed at improving the business management ability and knowledge/information management ability, which is one of the weakest area for domestic companies participating in LNG projects, so that Korea can be better equipped for global competitiveness. The study also aims at improving the bidding power for higher added-value field in the long run.

Since this is the initial stage of our research, the missing parts will be actively supplemented. The study also plans to build a comprehensive knowledge management system throughout the life cycle as its final objective.

### Acknowledgment

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## P6-7

### AN ASSET MANAGEMENT ASSESSMENT MODEL FOR STATE DOTs