상선 설계를 위한 엔지니어링 프로세스 관리 시스템

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Engineering Process Management System for Commercial ship Design

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Abstract

As the competition among commercial shipyards gets more intense and the number of ships to be designed is increasing significantly, the state is that engineering work volume has increased proportionately. Under these conditions, various attempts have been tried to improve performance in design activities and it has come to a vital issue as to how the design process should be managed and conducted in more efficient manner. To achieve this goal, an engineering process management system has been developed, named ' DSME Engineering Wizard System' . It aims to accelerate process performance by managing execution, promoting collaboration and maximizing engineering data reusability based on workflow concept.For the application of this system, Marketing Design which is one of the major processes for commercial ship design was analyzed and established into a unique workflow template consisting of activities, getting design experiences organized into a best practice in which engineering tasks are performed in the way proven most efficient..

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1. Introduction

Since a couple of years ago, Korea shipyards aimed a very aggressive sales target and have tried to achieve it.

This strategy means engineering work inevitably keeps increasing and it requires higher efficiency.

When looking into commercial design process from one point of view, there are some points causing inefficiency from engineers in their work procedures.

First, there exist different work practices among engineers even when they are involved in the same kind of work because a standardized process is not defined.

Second, despite the fact that most of the deliverables produced from engineering work are data in document format, there is not a sufficient management system for supporting engineering work itself.

Putting these together, briefly, business environment can be described that tasks, people, data and tools are managed separately by individual practice and comes out as a result of various experiences and works which eventually poses a barrier against business productivity. Figure 1 illustrates this present business environment.

To solve these problems, the system named ' DSME Engineering Wizard' was implemented. This system can manage engineering processes and information together using BRIX development framework provided by DNV software.
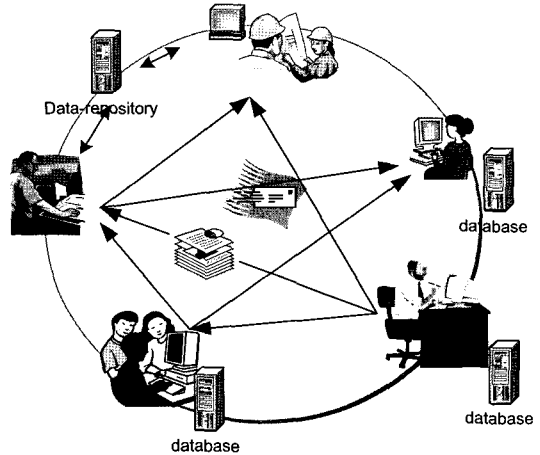

Fig. 1 Present business environment

2. Best Engineering Practice

While building a considerable number of ships for decades, Korean shipyards have come to form its own design practice in terms of design and production uniqueness.

Commercial ship design is comparatively known as being able to be described in a simple and typical way. But as design work requires complex interaction with other many design disciplines over a long period of time, when it comes to tasks, individual engineer manifests differences in their practice to processes, deliverables and methods.

This means while experienced engineers are good at acquiring information needed for the work and communicating with people whom their works are related to, others have difficulty in doing the same work with the same level of quality and efficiency.

Like the model Szulanski proposed [1], to make a best engineering practice of experienced one shared, three components are practically

needed: 'Donor', 'Recipient' and 'Context' in a knowledge intensive organization.

But adding shipbuilding design environment on the model, we can realize that 'Donor' is not only experienced individual as ship design consists of many tasks performed by the collaboration of people who are in charge of each party. That gives us an impression that 'Context' can not be what is on his or her personal agenda alone.

So if we are to organize a best engineering practice, boundary of 'Context' needs to be expanded to the one engineering process by which related tasks and official organizations are included.

'Practice' should be deduced from the experiences *to be able to drive in a better way* and should not only be a replication of experiences themselves.

One thing we should not fail to notice is that best engineering practice is created not for definition to be read but for practical application *to be used.*

If we can define best engineering practice in shipbuilding industry as a collective knowledge, a set of the methodology and tools capturing knowledge including process like what was proposed by Hiekata [2] is essential.

It has, however, some limitations in that it has nothing to do with execution of process itself while it acquires knowledge in the format of workflows (process) and documents attached to them. The system plays a role like a dictionary in which they can look up for processes when they

want to learn what or how to do a process. So, as business environment is changing, it is hard to maintain its real work and knowledge definition identically.

Paying attention to those points, Marketing Design process was chosen as a target to be analyzed and a CoP was organized to extract its best engineering practice. The members consisted of project leaders and experienced end users from each functional design discipline.

3. Engineering Data Management

As mentioned, most deliverables from engineering work can be generated in document forms. It is true that there are many raw data used and exchanged from the database but when a unit task is completed, usually they are *summarized into a specific document.*

Although a document management system has been adopted and is being used in DSME like in many other companies, as it is developed to support general management technique for all business areas belonging to enterprise, it is not distinctly harmonized with engineering work.

This means engineers themselves are the ones who have to search data they need for a specific task in each project and are in charge of managing data apart from their major engineering works. This implies they have to spend extra time in managing data.

To store the documents, they still use local storage and shared disk aside from the document management system. This situation does not inhibit them from duplicating documents over several data repositories and

make it difficult to control document versions.

Consequently, when they want to find a document for reference or reuse, there exists a possibility that wrong data could be referred to depending on who is searching, when he is searching or where he is searching. This usually decreases the efficiency of data reusability and once wrong data happens to be used then much time and communication are consumed to fix it.

Discussion about those problems turns out that building a new system which support engineering process and manage information together with it is required. The system aims to give a mechanism of managing data integrated with their tasks among project members.

4. Marketing Design Process

4.1 General

'Marketing Design' means a process which covers the pre-contract engineering work in shipyard

The process is for generating weight and cost estimation and technical documents of a ship as its deliverables when an inquiry project is initiated by customer request. These inquiry projects are carried out three or four times as much as contract projects in a year and the role of Marketing Design in shipbuilding design is shown in Figure 2.

Especially as it gets involved in determining major design specification by all the participating design disciplines on the assumption that the ship is going to be built in the yard, the process becomes a reduced-sized version of all ship
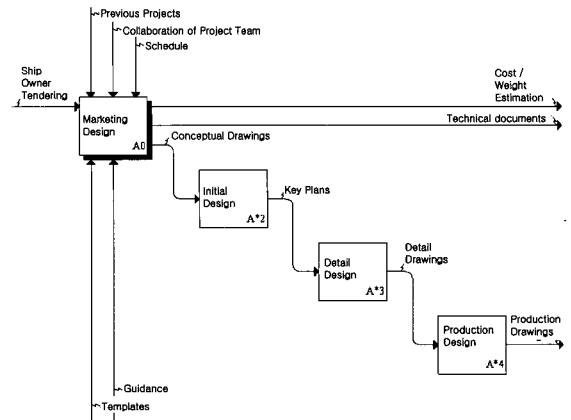

Fig. 2 Marketing design in shipbuilding design

designs carried out through the whole design process and one of the important processes as much.

4.2 Project Setup

When customer requirements are received, a project team for the inquiry is organized. A project leader is selected to conduct the process and from every design discipline, designers are assigned.

Due to the number of inquiry projects, in many cases, an engineer carries out at least two or three projects simultaneously. So organizing and keeping project members to work in a timely manner is quite important.

When the project team is organized, project leader informs members of what should be done for the project in terms of work order including project information and schedules.

4.3 Determination of Main Specification

Among design disciplines, hullform, structure and basic design parts are doing major roles in designing the main specification of the ship.

Hullform is designed and major hull structures are decided. During the basic calculations, the design is reviewed to see its design appropriateness.

While doing this, each design is not independent of other functional part's design and there exist lots of mutual interactions among them to discuss and deliver data.

So far, those kinds of interactions have been done by offline meeting and printed drawings or partial online communications.

Basic design creates G/A which contains most of major information and distributes it to other functional design parts to generate their engineering calculation for the estimation.

4.4 Cost Estimation

Based on the major specification and equipment list from the previous stage, various kinds of engineering calculations are performed to estimate cost and weight for each functional design discipline. For instance, to decide a generator capacity, electric design collects electric load data needed for machinery, accommodation and so on, and summarizes it according to a certain rule.

All participants complete cost and weight estimation by feeding a company in-house system with calculated data and then the project leader reviews the summarized estimation result and makes it confirmed.

4.5 Documentation

While a series of cost and weight estimation tasks are being done, technical documents for ship owner are prepared.

Although there are some differences in its format, all the kinds of documents can be put together. For example, outline specification and full specification are major documents which contain most technical items for contract later and builder's reply documents are created for dealing with customer's request or question.

Usually one document is created with contributions from all the participants. Project leader provides document template and commits each part of the document to participants according to the design disciplines and keep monitoring the documentation progress.

When all data are prepared, the project leader collects them into a document and asks it for review from all participants and others who need to look into it.

During modification of the document by considering comments from review, there could be several iterations.

4.6 Publishing of Deliverables

As deliverables of Marketing Design, cost and weight estimations are delivered to other teams out of design division. This is an official correspondence among teams and the project leader needs to keep its history and contents. Like this way, completed documents are to be transferred to marketing department.

The sequence of Marketing Design has a stream from project setup to publishing of deliverables. To analyze more detail activities and roles, Use Cases diagrams were produced as illustrated in Figure 3.
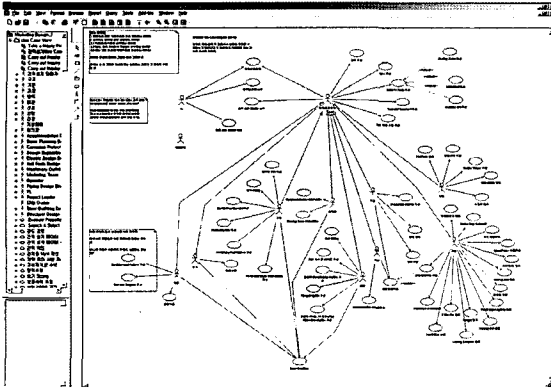
Fig. 3 Use cases diagram for marketing design

Fig. 4 Concept of DSME engineering wizard based on workflow technology

Basically designers try to focus on how to satisfy customer's requirements and minimize shipbuilding cost without undermining quality. To do that, more time should be spent in developing new products; enhancing their engineering skills and studying new technology coming from vendors. Not to mention the resources consumed in communicating and data managing.

To lessen the inefficient elements in the process and to help designers to accomplish many projects concurrently with quality and efficiency, a new scheme was proposed.

5. DSME Engineering Wizard System

5.1 Concept

As outlined in section 2, for defining the best engineering practice extracted and implementing it as a executable environment, workflow technology was chosen and 'DSME Engineering Wizard System' was developed based on BRIX framework which DNV software provides and contains workflow management module in it [3].
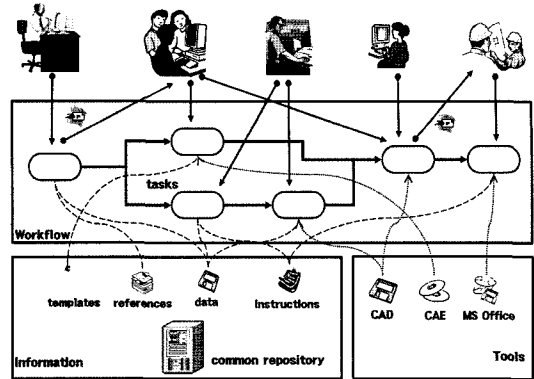
In reality, many independent management systems and database are used for each individual engineering task.   This makes it difficult to settle a workflow system for daily work because users get the impression that they need to manage additional system unless the system has something to do with their tasks.

So this system is designed to give a workplace for them to carry out Marketing Design from the beginning to the end. Process is supported as an activity defined in process template and data is provided for each activity. With this, basically they can carry out a process in a solitary environment.

As illustrated in Figure 4, the solitary environment serves information and tools related to tasks controlled by workflow mechanism. Other functional features of the system are explained in section 5.3 for this concept.

Medina-Mora [4] categorized processes in an organization into material processes, information processes and business processes. He described business processes as market-centered descriptions of an organization's

activities, implemented as information and/or material processes.

Business process reengineering involves explicit reconsideration and redesign of the business process. It is generally performed before information systems and computers are used for automating these processes. Information process reengineering is a complementary activity of business process reengineering which involves determining how to use legacy and new information systems and computers to automate the reengineered business processes. The two activities, Business Process Reengineering and Information Process Reengineering, can be performed iteratively to provide mutual feedback.

Although the system developed does not serve business process reengineering for its purpose, the best engineering practice is organized into a workflow template and functions are implemented to support it. Somehow a similar effect was brought about by changing the way how they work.

5.2 Modeling of Process

According to the Workflow Glossary [5], business process is defined in a Process Definition to be used to create and manage Process Instances.

Using the Template Editor of workflow management module in the BRIX development framework, Marketing Design process was organized into a workflow template for its definition.

5.2.1 Workflow Template

Marketing Design process was analyzed mainly by interviewing end users over a period of time and disassembled activities which are performed for a process. For each activity, relationship of sequence and dependency is defined.

Activity tools which are developed for Marketing Design also assigned to provide functions for activities like collaboration, data management and so on, needless to say, the process advances.

5.3 Execution of Process

The development framework used for this system provides a Workflow Explorer which allows users to view the processes.

If taking a typical example of workflow management system realizing a document approval process based on the workflow enactment service [6], users usually can see the data or documents ' delivered' by workflow engine controlling behind from the previous activity which has been done by another user. Entire process is hidden to participants and only manager can monitor the status of whole activity in terms of start, on work and end.

In case of Marketing Design, it is not so useful if the system provides a separate GUI and data to users respectively because most of activities require collaborative work to be done concurrently. So, this system exposes all activities to all participants using the explorer.

While the order from one activity to the other is automated by the workflow engine, the project leader is doing a role of leading a real process

using the system. Process control depends not only on the rule mechanism defined template but also on the project leader's intervention. The other participants are to do their tasks according to his activities which is notified to them by the system

One instance of the workflow template is initiated when a new inquiry project is registered and a project name is given. All participants can see the specific project through the explorer and make it progress by utilising the tools related to activities shown in it like menu-based on leader's guidance. When an inquiry project is created, it gives integrated work environment shown in Figure 5

Basically all communication and data/document management for the Marketing Process are designed to be supported in this system. By providing an engineering workplace environment like this to have participants working together, project management could be done with the progress as well.

5.3.1　　　Acceleration of Collaboration

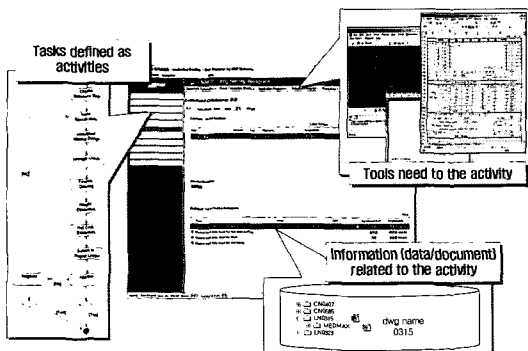As mentioned in section 4.1, many troubles are caused by the complexity of interaction

Fig. 5　Integrated work environment

among participants.

A project team consists of a dozen of designers who come from different departments in design division. Most of them have more than two projects concurrently at hand.

Project leaders should know who is in charge of a functional part for each project and all participants should know one another too.

The way how they communicate is also confusing. The interview about this reveals that users happen to choose different ways like email, hard copy, phone and so on according to the condition they have at the moment. Communication history could not be maintained, consequently, exchange of information tends to be duplicated or omitted.

To help the process with this point, the system was equipped with a new messenger module which was agreed to be used for communication and all information were specified in the system so that all participants can refer to the latest data without duplication. One who is responsible for creating data or documents uses the system to distribute them to others and the system keeps track of the history. The messenger is used too for notification purpose in manual or automatic way.

As defined by Jim [7], collaboration entails a more complex aggressive team-based approach as compared with cooperation which simply calls an agreeable joint effort.

Marketing Design is a typical example of the collaboration compatible with the definition. This system supports some of the unique features

which can be found in collaboration applications such as the following:

- Ability to see if a document has changed without actually opening it
- Capability to receive scheduled notification of changes by email leading directly to the change
- Document management and control solutions
- Ability to establish levels of user security and access rights
- Open instant messaging

5.3.2 Maximum Reusability of data

The environment described in section 3 explains why document management is so important for engineering work. Generally in shipbuilding industry, every ship has its own peculiar features which make its design different from any other ships. In most of the cases, however, design starts from a variation of similar ships designed previously and not from scratch. Data reusability is one of the key factors to improve design efficiency.

A couple of methods have been tried such as managing the documents in a shared disk by a naming rule or using document management system for the purpose. But the results showed that there exists obvious limitation with the management in a static manner because the data and documents kept changing in its format and stored in different versions repeatedly by participants while they are generated.

So based on the analysis, this system integrated the data and documents into the process. Moreover, the data and documents can be searched easily because integration with the
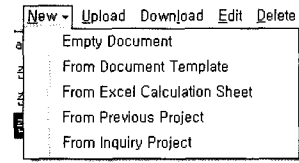

Fig. 6 Creation document by reusing mechanism

process means a context in which documents are used and the context is the clearest concept users can recognize as their work. This system also provides a function of reusing the documents searched automatically.

When a new document is created, functions shown in Figure 6 can be used. It is possible to create a document by filling new contents in standard template. If there is a document created in any previous project, it is also possible to create new document by choosing the previous document and modifying it.

As an example of data sharing, Figure 7 shows a screen in which participants input each data whenever they create or modify it and is notified using messenger. When one needs data for his task he can find the data here and if there is not available data at that moment he can ask for it through the request function. All this interaction leaves its logs to keep track of data reference relationship.
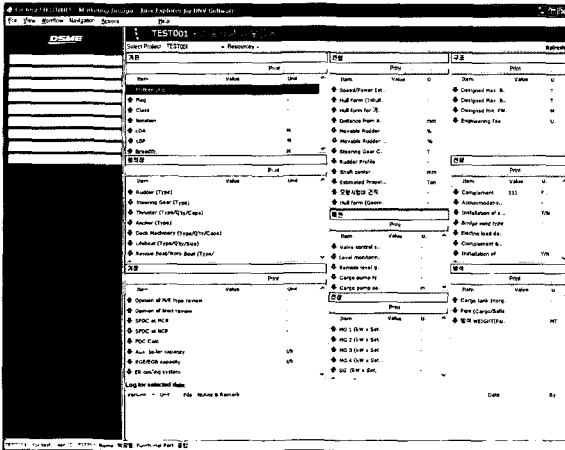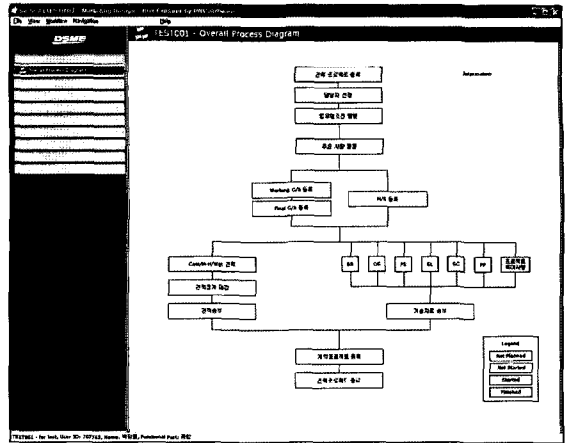
Fig. 7 Engineering data sharing and reuse

Fig. 8 Process monitoring

5.3.3   Project Management

Actually, a project leader of an inquiry project is in charge of the process and takes a role of project manager as well. Like all other projects, for Marketing Design, it is important too to conduct the deliverable completed and make sure they are delivered on time.

As all of the activities are supposed to be covered in this system and the deliverables are kept with them, the project leader can always monitor the progress status and coordinate problems occurring among participants. In addition to monitoring the whole process and documentation procedures, a function for the project leader to be able to make a log of important events that happen along the process is also implemented.

Figure 8 shows the process monitoring screen which indicates the status of a specific project. With this, all participants and managers can see the overall status at a glance and major information of each activity as well.

5.3.4 Engineering Workplace

To supply the system as a total solution so that the end users can carry out the engineering tasks for Marketing Design without being confused, a mechanism was considered by which users can have reference materials, data, software and templates altogether for each activity. With this, knowledge, tools and data needed for accomplishing the activity are provided in one screen, thus, eliminating the troubles of moving several systems for the users as shown in Figure 5.

6. Conclusion

Noting the situation that the competition is getting harder in shipbuilding industry, the necessity of managing processes becomes more substantial. Especially to serve engineering process efficiency, DSME Engineering Wizard System was implemented realizing best engineering practice based on workflow technology and has been applied to Marketing Design process performed in DSME. As a result of it, it is expected that engineers can get the tasks accomplished effectively by following the

system control and using data and tools prepared, and moreover, the process itself comes with the capability of being improved by the knowledge captured with the context.

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