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Development of a Collaboration System based on Mobile Framework in the Field of Ships and Marine Industry

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Abstract

Engineering information in the shipbuilding and marine industry should be inevitably modified owing to frequent changes in, for example, customer's requirements and product specifications. Such a working environment caused by a discrepancy in information between engineering and production departments can have inefficient effects on production tasks. In order to perform efficient production tasks, staff in a production department should have easy access to the latest information in engineering. Furthermore, information should be easy and prompt in sharing and searching when needed. In this paper, we propose a development of collaborative system based on mobile framework. This proposed system facilitates its application to the work environment in the shipbuilding and marine industry. Moreover, it particularly saves resources in shipyards such as energy and costs of labor and materials. Mobile techniques, such as XML, SOAP and Android, which have been used in this paper are useful for implementing functions of sharing and searching for information in a distributed environment. The purpose of the system proposed in this paper is to provide system users with a collaborative environment which is based on an online and paperless mobile framework, when different kinds of tasks are required due to changes in engineering information. This proposed system not only can check information in production tasks in real time but also can implement functions based on mobile framework. By reducing the discrepancy in information between the engineering and production departments, this collaborative system can be implemented effectively.

Keywords: *Shipbuilding, Mobile Framework, Paperless, Real-time, Engineering Change, Visualization, Collaboration System*

1. Introduction

Marine shipbuilding has become high technology industry caused by Engineering-to-order (ETO) and short delivery [1]. ETO manufacturing is described shipbuilder to produce complex products that are required to unique engineering design and significant customization throughout product lifecycle by ship-owner [2, 3]. There may be a few exceptions, but in general each ship has special system requirements even in same ship-owner since shipbuilding process comes loaded with ship-owner`s option items. New requirements are composed with combination of ship-owner`s option items. As part of need to manage the requirements, the change order cost of materials and vendor system has been determined [4]. Ship-owner `s requirement, the change of vendor design, and new fabrication method are more often the cause of engineering changes of offshore plant project than that of general

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Container Ship, LNG Tanker, Bulk Carrier, etc. Such the requirements of engineering changes and applied costs have become an accepted practice in the shipbuilding process. These new requirements of offshore plant project are the field that is not known to oil major and shipbuilder. It is not all simple and straightforward for shipbuilder to use efficiently finite resources such as manpower arrangement, demand and supply management of materials, preventive action, risk register, manufactured tool, construction method, production scheduling, and equipment operation of forklift, crane and transporter on the basis of previous training experiences. Many supervisory systems, information gap between engineering and production, lack of required information to work in any available form, and limited yard IT environment are also burdensome for shipbuilder. These are cause of unnecessary duplication of management such as the PND delay of material, assembly lag and lack of assembly block storage space, rework of installation and painting, and modification of critical path.

The understanding, management of ship-owner`s product specification, and the efficient information extraction of general arrangement are needed in ETO manufacturing environment. Since engineering information is the basis of ship construction, the accurate process management on engineering changes and BOM updates regards as critical factor [5]. Engineering information is used as an important part of Management Information Systems (MIS), procurement and purchasing on material, production management, and customer management system. Integrated MIS and engineering information has been studied, for examples, Enterprise Resource Planning (ERP), Advanced Planning and Scheduling (APS), Supply Chain Management (SCM). Product Data Management (PDM) or Product Lifecycle Management (PLM) is described by the applied progress due to engineering changes. The UML mapping diagram is presented in integrated visual relationship heterogeneous CAD and PDM.

The aim of this paper is to propose a real-time and paperless system using mobile framework for site employee to improve productivity of shipbuilding in ETO manufacturing environment. The proposed shipbuilder`s mobile framework is expected to take effect business transactions, decision making, communication cost saving in that respect of real-time communications and collaboration.

The mobile framework is categorized to three types of function such as termination, server, and network. Termination side defines mobile service framework area such as operation system, native app. or hybrid app. support, and data transmission. Server side describes data processing, data transmission, and security. Network side indicates public network, secured intranet. Prototype mobile server of DSME yard has been developed considering communication infra system and security, and prototype mobile application is also consisted with user friendly interface system which user`s key-in is minimized. Section 2 provides the revision workflow of engineering drawing and document due to engineering changes, improvement issue of manufacturing, and needs of mobile framework between engineering and production. Section 3 presents a shipbuilder`s mobile framework, the structure and data-flow of mobile service server. Section 4 and 5 show various prototypes of mobile applications and the concluding remarks.

2. Production Issues and Suggestions

The revision workflow of engineering drawing and document on engineering changes. What make engineering design changes are requests from ship-owner, vender and production discipline of ship builder.

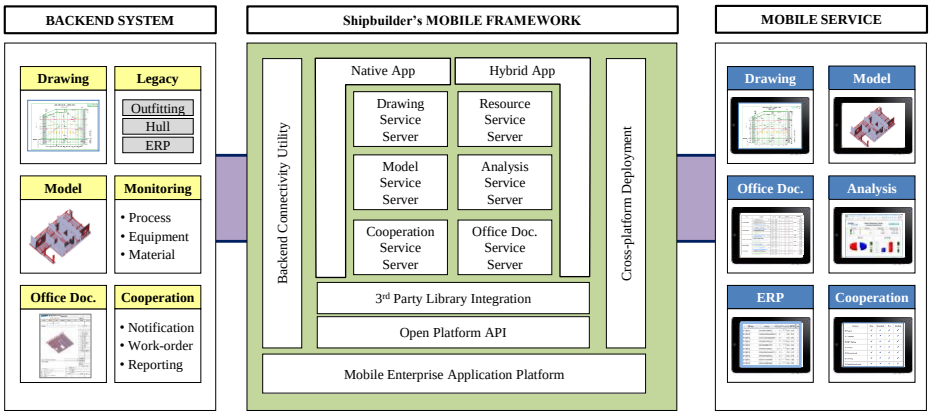


Figure 1. Shipbuilder's Mobile Framework

The efficiency evaluation variables for production work process consist of Quality of product, Cost of production, Delivery of product or information, and Flexibility on schedule change. These QCDF (Quality, Cost, Delivery, and Flexibility) are analyzed for finding problems by engineering changes. By application and enhancing of information systems, shipbuilder can have enough facts to resolve the matter. This paper proposed that mobile framework can improve the efficiency of information delivery, minimize the risk caused by lag of decision making, information gap between engineering and production. The Delivery purpose of information is to minimize a bottleneck phenomenon of critical path, monitor a production result according to process, and focus on connection between human-and-human, human-and-machine and machine-and-machine. The proposed shipbuilder`s mobile framework is shown in Figure 1. After engineering changes are complete, mobile framework has been given production drawing, schedule, planning of manpower and material, and production results for site worker when they are needed.

3. Structure of mobile framework

3.1. System Structure

This paper was limited to consideration of android mobile terminations to visualize production information. The proposed mobile framework is shown in Figure 1, and consist of backend systems, shipbuilder`s mobile framework, and mobile services. Backend systems provide a data source of CAD model, production/engineering drawing, schedule, process, office documents. The data from backend database is organized into various business services of mobile applications in a mobile framework. The reconstructed data is transmitted to mobile client via SOAP (Simple Object Access Protocol) that is a simple XML-based protocol to let applications exchange information over HTTP.

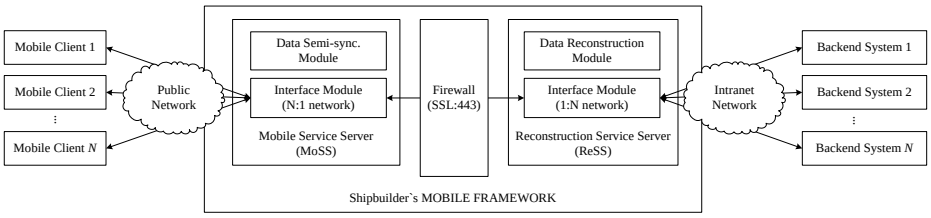


Figure 2. The structure of mobile server

The main shipbuilder use LTE, HSDPA, Wibro as public network in yard communications environment. But LTE, HSDPA, and Wibro pose a threat to security for companies that rely on value technology. The structure of mobile server in Figure 2 will meet the security requirements and send the reconstructed data much faster than before.

3.2. Mobile Server Configuration

The mobile server is Windows-based console application system, comprised of two servers such as the Mobile Service Server (MoSS) and the Reconstruction Service Server (ReSS). Site worker calls on engineering information and status to the MoSS using mobile applications. The MoSS transfers the data to mobile applications via SOAP service. MoSS and ReSS have created a XML file with an inquiry response backend system provided. The drawing and office documents are converted into image file. A needed component for conversion is Ghostscript and drawing viewer API. The mobile service complied with industry security standards, such as SSL (Secure Socket Layer). The SSL certificate is what establishes a security session between the server-and-server and the user-and-server. Because the mobile service data is being streamed over a public network with SSL channel, drawing and documents not stored in mobile client.

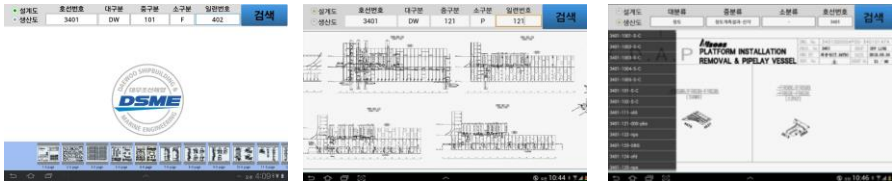
4. Prototype Mobile Applications

The mobile services focused on user interface style, input mechanisms, response time, simplicity of experience, interaction on a multi-task.

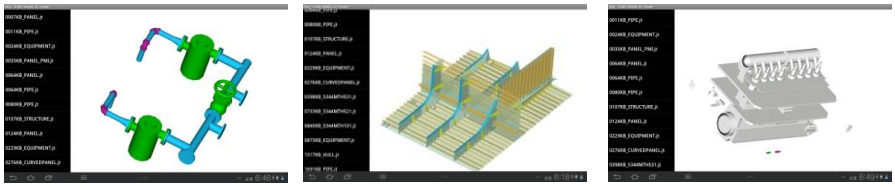
These applications consist of process monitoring service, cable installation-support service, drawing viewer service, and model viewer service. The process monitoring service app. has been developed for the inquiry of production schedule, shop worker, and material information at yard environment. This is also consisted with user friendly interface system which user`s key-in is minimized. When users have logged on to the service, process monitoring mobile app. combines ship`s project no., block no., materials, drawing, work order, schedule with the personal organization code that obtain from users.

(a) process status monitoring service (schedule, shop, material)

(b) cable installation-support service (barcode scanning, detailed cable information)



(c) Engineering / production drawing viewer service



(d) CAD model viewer service

Figure 5. Prototype applications using mobile framework

This could lead the way to more personalized service. A cable installation-support service app. has been developed for the inquiry of detailed cable information, installation information at yard environment. Every piece of cable line has a barcode. User`s key-in is minimized since a barcode on the cable are read by built-in camera. Whenever users scan a barcode, they can know what they have and they need. The installation information is consisted of completion date, cable length, reworking code, reworking description, etc. The detailed cable information includes cable type, size, node, pallet, etc. This service reports the latest in current events even in engineering changes. An engineering/production drawing viewer service app. has been developed for the viewing of the drawing at yard environment. The service functions include predictive text input of project no. and block no., drawing category, tree panel, and zoom in/out. This service reports the latest drawing in current events even in engineering changes, too. A CAD model viewer service app. has been developed for the viewing of the 3D CAD model to better understand a work model. The visualization techniques of 3D shapes use OpenGL ES. The features have the viewing of 3D models directly from a server, no additional native application need to be installed, and control with zoom, pan, rotate.

5. Footnotes

The purpose of the paper is to provide the overall production system information with respect to design and law data which are directly influenced on decision making of field workers via mobile framework in order to productivity improvement of ship fabrication. The interested shipbuilding information due to engineering changes is production schedule for blocks, human-resource, material, and drawing information in ERP. The prototype mobile applications are to achieve maintenance of information consistency for overall life-cycle of product, support efficiently to decision making and expedite work process with regard to cooperative work, and accomplish cost saving.

Acknowledgements

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