Faculty of Manufacturing Engineering

IMPLEMENTATION OF QUICK RESPONSE (QR) CODE IN CLOUD MANUFACTURING (CM) FRAMEWORK

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DECLARATION

hereby, declared this report entitled "Implementation of Quick Response (QR) code in oud manufacturing (CM) framework" is the results of my own research except as cited in ferences.

Signature : .....

Name : NUR HALIMAH BINTI JAMALULIL

Date : 25 SEPTEMBER 2016

APPROVAL

hereby declare that I have read this dissertation/report and in my opinion this ssertation/report is sufficient in terms of scope and quality as a partial fulfillment of aster of Manufacturing Engineering (Industrial Engineering)

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Date : 26/9/2016

DEDICATION

To my beloved parents and sister

ABSTRACT

Cloud computing, information and communication technologies (ICT), and Internet of Things (IoT) have evolved into key assets in a manufacturing firm, particularly as a medium in transmitting information to specific parties. Cloud manufacturing (CM), which has espoused both technologies, has rose to prominence in terms of transforming the existing manufacturing practice in firms into a service-focused, customer-oriented, demand-powered, and extremely collaborative process. Thus, the deployment of CM in a shipbuilding firm aims to address multiple problems that had cropped up. The concerns faced by the shipbuilding firm are: (i) ever-evolving demands and expectations from consumers, (ii) insufficient inter-dependent mediums of communication, and (iii) wastage of material in manufacturing. To address these issues, this study intends to recommend a new framework which can envisage the CM assimilated with the work processes which are to be executed in the shipbuilding firm. The entire manufacturing process in the X boat model is examined for formulating the framework. For the framework to be worked out, the present workflow and customs of the shipbuilding firm for the creation of the X boat model are determined and structured. This helps identify the issues with the present framework as well as the crucial departments which require improvement. These departments are as follows: (i) production planning, (ii) engineering & design, and (iii) store. Enhancements are carried out on the identified issues of these departments for formulating the new framework. As the majority of the arising issues pertain to the communication system in transmitting information within departments, the CM concept is deployed across the cloud data storage. This storage is the place where information is stowed and then accessed through the Quick Respond (QR) code system organised for the firm. The assimilation of the QR code system and cloud data storage is envisaged in the recommended framework. This framework is then substantiated by implementation verification and is corroborated through the face validity method. Following the substantiation and corroboration of the new proposed framework, the execution of the QR code system which focuses on the CM concept and the feasibility of the system have been elucidated in detail. This, in turn, is able to enhance the production and communication workflow in the shipbuilding organisation.

ABSTRAK

Pengkomputeran 'cloud' (awan), teknologi maklumat dan komunikasi (ICT) dan Internet Perkara (IoT) telah berkembang menjadi aset utama dalam sebuah syarikat perkilangan, khususnya sebagai medium dalam menyebarkan maklumat kepada pihak tertentu. Pembuatan 'cloud' (CM), yang menyokong kedua-dua teknologi, telah dapat meraih popularity dalam merevolusikan amalan pembuatan semasa dalam syarikat-syarikat kepada pembuatan yang berorientasikan perkhidmatan, pelanggan, permintaan, dan kerjasama yang tinggi. Oleh itu , penggunaan CM di sebuah syarikat pembinaan kapal adalah untuk mengatasi beberapa isu berbangkit telah mendapat perhatian. Isu-isu dalam syarikat pembinaan kapal itu adalah: (i) permintaan pelanggan yang sentiasa berubah, (ii) kelemahan media komunikasi perantaraan antara jabatan-jabatan, dan (iii) pembaziran bahan-bahan pembuatan. Justeru, bagi mengatasi masalah ini, kajian ini telah menyasarkan untuk mencadangkan satu rangka kerja baru yang dapat menggambarkan CM yang bersepadu dengan proses kerja yang dilaksanakan di syarikat pembinaan kapal tersebut. Keseluruhan proses dalam pembuatan model bot X dikaji untuk mereka rangka kerja tersebut. Untuk rangka kerja baru itu, aliran kerja semasa dan amalan pembuatan syarikat pembinaan kapal untuk model bot X telah dikenalpasti dan distruktur. Dengan berbuat sedemikian, masalah dalam rangka kerja semasa serta jabatan-jabatan yang kritikal yang perlu ditambahbaik dapat dikenalpasti. Jabatan-jabatan kritikal tersebut termasuklah: (i) jabatan perancangan pembuatan, (ii) jabatan kejuruteraan & reka bentuk, dan (iii) jabatan stor (inventori). Penambahbaikan dibuat terhadap masalah yang telah dikenalpasti pada jabatan-jabatan tersebut, bagi merealisasikan rangka kerja yang baru. Memandangkan kebanyakan permasalahan yang timbul adalah berkaitan dengan sistem komunikasi dalam pemindahan maklumat antara jabatan, konsep CM telah diaplikasikan melalui penyimpanan data 'cloud'. Penyimpanan data 'cloud' ini adalah di mana semua maklumat disimpan dan boleh diakses melalui sistem kod 'Quick Response' (QR) yang telah ditubuhkan untuk syarikat itu. Dengan itu, integrasi antara penyimpanan data cloud dan sistem kod QR telah digambarkan dalam rangka kerja baru yang dicadangkan. Rangka kerja yang dicadangkan itu kemudiannya disahkan melalui pengesahan pelaksanaan (implementation verification) dan divalidasikan melalui kaedah 'face validity'. Berikutan bukti dan sokongan untuk rangka kerja baru yang dicadangkan, pelaksanaan sistem kod QR yang bertumpukan kepada konsep CM dan kebarangkalian untuk sistem ini telah dijelaskan secara terperinci. Justeru itu, perkara ini mampu bagi meningkatkan pembuatan dan komunikasi aliran kerja dalam organisasi pembinaan kapal.

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CM	-	Cloud manufacturing
QR	-	Quick Response
IoT	-	Internet of Things
ICT	-	Information and Communication Technologies
AI	-	Artificial Interlligence
IaaS	-	Infrastructure as a Service
PaaS	-	Platform as a Service
SaaS	-	Software as a Service
Xaas	-	Everything as a Service
CSP	-	Cloud Server Provider
TPA	-	Third Party Auditor
PRP	-	Physical resource provider
OEM	-	Original equipment manufacturer
RFID	-	Radio frequency identification
VM	-	Virtual Machine
EC2	-	Elastic Compute Cloud
OS	-	Operating System
iOS	-	iPhone Operating System
QoS	-	Quality of Service

SLA	-	Service Level Agreement
AHP	-	Analytical Hierarchical Process
SMI	-	Service Measurement Index
V&V	-	Verification and validation
MRF	-	Material Request Form
QA	-	Quality assurance
QC	-	Quality control
BOM	-	Bill-of-material
MS	-	Microsoft
XLS	-	Solid Work Excel file
TB	-	Terabyte
GB	-	Gigabyte
MB	-	Megabyte
WFMTS	-	Wheat Flour Milling Traceability System
5W1H	-	What, who, why, when, which, how

CHAPTER 1

INTRODUCTION

This chapter is introducing the causes and the existing problems which initiate this study. It is followed by the background of the study and the narrowed-down objectives. By the end of the chapter is the clarification of project scope to set the boundary of the study where it should be within.

1.1 Motivation of study

In the manufacturing industry, there are two major influential trends for abundant transfiguration that are currently been focused on. Firstly, the intensifying rivalry with abridged-income countries in the industry, inflicts companies to come up with an alternative methods to have the upper hand in the competition (Dowlatshahi and Cao, 2006; Schulte et al., 2014; Mauricio-Moreno et al., 2015). Secondly, the evolution of Information and Communication Technologies (ICT) and Internet of Things (IoT) technologies accommodates the manufacturing industry with the objective to overcome the competitive threats by actualizing production processes, which are eminently responsive and efficient (Davis et al., 2012; Seiger et al., 2015). By utilizing ICT and IoT technologies, will enable companies to apprehend manufacturing processes that appease

consumer requirements; which usually revolving in the large series manufacturing, mass customization, inconsistent order rates, and brief time-to-market (Zuehlke, 2010; Mauricio-Moreno et al., 2015).

The merging of cloud computing, IoT, service computing, ICT, and Artificial Intelligence (AI) leading to a concept known as cloud manufacturing (Li et al., 2011). Cloud manufacturing (CM) is a smart structured production model that espouses cloud computing, contemplating to meet the increasing demands for greater merchandise individualization, expansive international collaboration, knowledge-comprehensive innovation and upsurge in dexterity of market-response (Ren et al., 2014). It is an approach that able to take service-oriented manufacturing processes to a higher level by integrating the fundamentals derived out of the cloud-computing area to the real-world manufacturing practices and consecutively aiding these practices by cloud-based software and IT infrastructure (Xu, 2012).

Consumers can auspiciously attain on-demand services, in CM, that advocate the whole product life cycle by means of network access to a joint group where allocated production resources are pragmatic and within affiliated management in a configurable and optimized way (Ren et al., 2014). The on-demand service can be achieved with the existence of cloud computing which has the ability to move rapidly from early adopters to mainstream organizations (Jackson et al., 2010; Wang et al., 2010). Most manufacturing industry begins garnering the advantages of cloud ratification nowadays, shifting towards smart manufacturing with the state-of-the-art lithe, extensible, and dynamic business proceedings, substituting conventional manufacturing business models (Xu, 2012). In

terms the ratification of cloud computing in the manufacturing field, it emphasizing on IT and new business models that the cloud computing can promptly assist, the convenience of escalating the fluctuation of demands, and adaptability in setting up and modifying solutions (Wei and Blake, 2010).

Service-oriented and cloud computing combined will indeed begin to challenge the way of smart manufacturing and enterprise computing (Tao et al., 2011). Notwithstanding to that, the capability in distributing, as mentioned by Jackson et al. (2010) and also Wei and Blake 2010), not only be able to abolish historical boundaries yet also reassure organizations to ponder more collaboratively and maneuver the industry more dynamically.

1.2 Research background

Shipbuilding industry will be the focal point for this study. A shipbuilding company has been observed and reviewed as the case-study company, thus problem identification has been made. From the observation and reviews, it has been detected that the company is experiencing material wastage due to uncoordinated information transfer through departments.

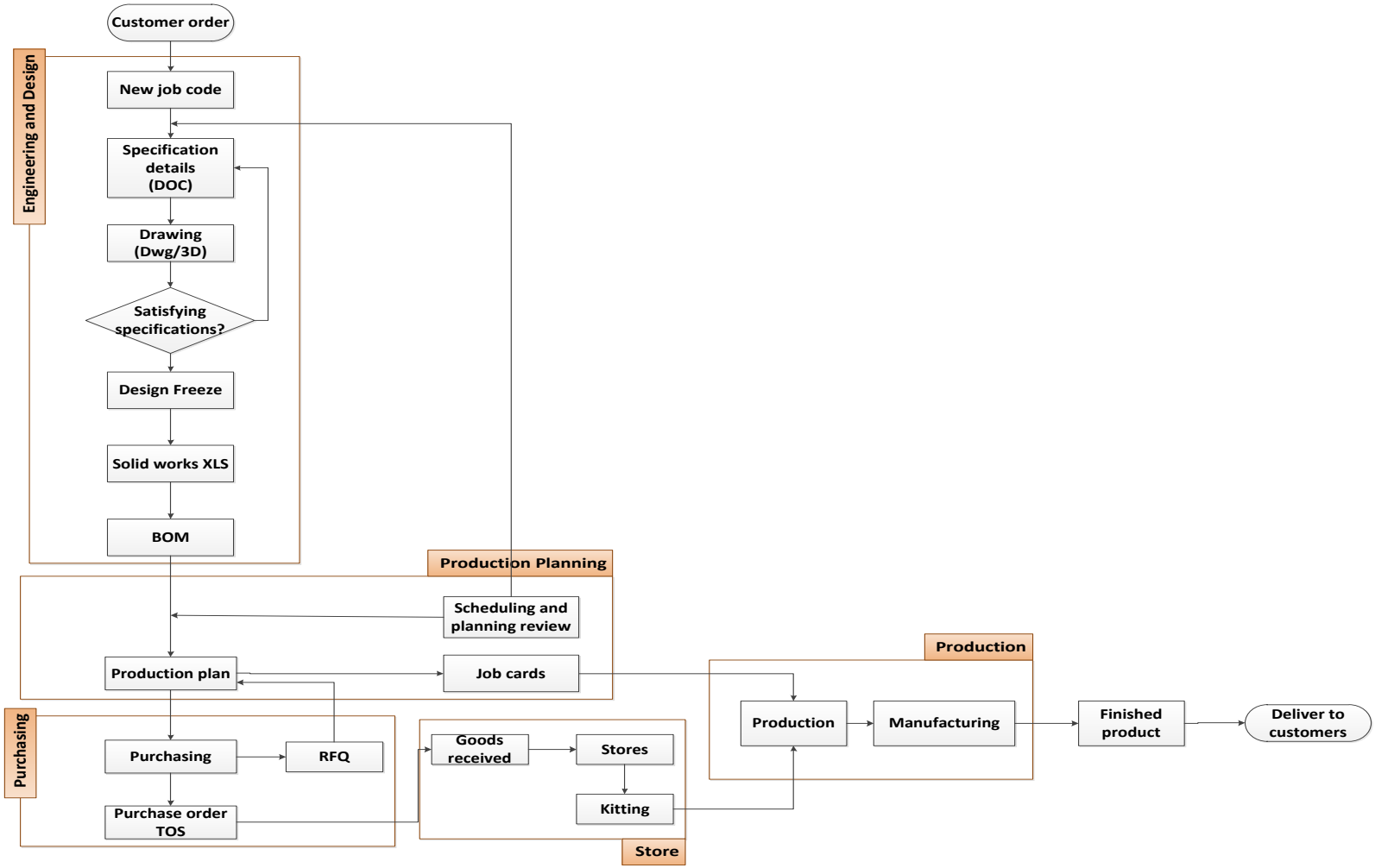

Figure 1.1 : Current operation flow of the shipbuilding company

Figure 1.1 illustrated the current operation flow that occurring in the company. Based on the figure, the product specification; as the input for the whole production; is conceived from the customers. All the customers' needs and demands are considered by the engineering and design department and a product design will be created. When the customers are satisfied with the product design and its specifications; such as the materials and the processes used to engineer the product; the manufacturing of the product will start.

Next, the production planning department will be issuing a job card according to the materials that had been particularized for the materials to be retrieved from store before starting the manufacturing of product. Shortly after the store department is informed by the production of the materials needed, the preparation of the materials will be done and materials are transferred to production to begin their work. When the work is done, inspection is executed before product is forked over to customer.

1.3 Problem statement

Based on the operation flow of the company shown in Figure 1.1, the problem within the company has been distinguished to be the communication deprived between engineering and design department with store department that arise whenever there is a lack of materials available in store brought difficulties for the production department. Since the only link between engineering and store departments is through the production department, it became a burden for the production department to overcome the issue of materials deficiency. In addition, the workload of the production planner is a lot in issuing a job card and it is time-consuming.

As a result, the process of issuing job cards is prolonged and the production is delayed. Therefore, it is crucial to have a linkage between engineering and design department and store department to overcome this situation. The communication existence of these two departments may deliver the information of the materials shortage on-time and the alternatives can be discussed over with the customers. Rather than using the production department as a linkage between engineering and design department and store department, a direct link would be a better solution.

Besides that, the company also had major issue in wastage of materials. Figure 1.2 represents the case-study company's information on the materials wastage. As shown in the mentioned figure, the materials for all seven product of X boat model have been wasted for almost 30% in average. This problem leads to higher production cost because more materials will be needed for the production of upcoming product since the holding inventory has been wasted. The materials wastage happened due to the poor production planning for retrieving the materials from storage. The materials that had been issued had not provide the adequate amount of materials needed for manufacturing of products but on the contrary, equipped the production floor with excessive materials. The issued materials that have been retrieved cannot be return to storage due to quality issue. The excessive materials are the one that contributed to the waste of materials.

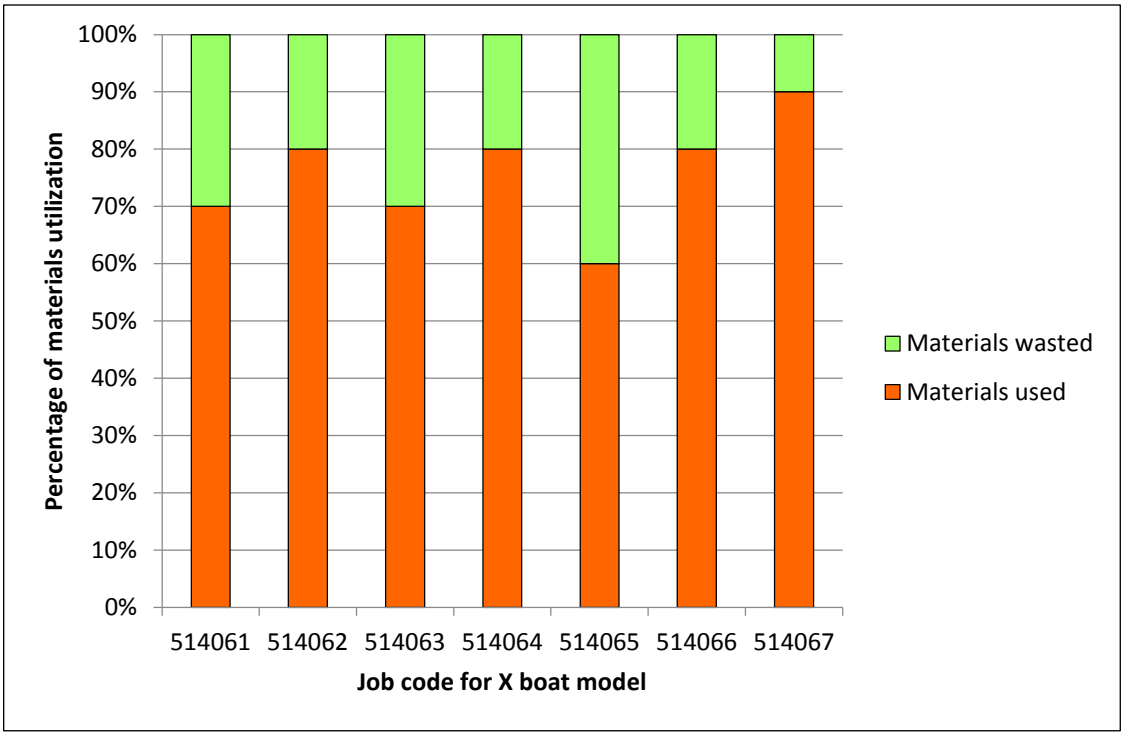

Figure 1.2 : Graph of material usage for X boat model (May 2015 - December 2015)

In overall, the lacking in the current operation flow (Figure 1.1) need to be overcome in order to have better communication medium to have accessible real-time manufacturing information and also need to reduce the materials wastage in production. But above all that, the company also has an ever-changing demands and expectations from customers. The customers' demands for the company usually involve the specifications for the design of boat, and materials utilization. Additionally, the shorten duration for product completion due to the customers' decision on changing the deadline also become a challenge for the company. This is mostly happen for the product X boat model (Figure 1.3) which has the production rate higher than other boat model. Hence, the company aimed to diminish any production issue in producing this product.