UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Manufacturing Engineering

FLEXIBLE LOT SIZE FOR KANBAN SYSTEM TO REDUCE MATERIAL OVERFLOW IN HARD DISC ASSEMBLY PROCESS

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FLEXIBLE LOT SIZE FOR KANBAN SYSTEM TO REDUCE MATERIAL OVERFLOW IN HARD DISC ASSEMBLY PROCESS

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A thesis submitted
in fulfillment of the requirements for the degree of Master of Science
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DECLARATION

I declare that this thesis entitled "Flexible Lot Size for Kanban System to Reduce Material Overflow in Hard Disc Assembly Process" is the result of my own research except as cited in the references. This thesis has not been accepted for any degree and is not currently submitted in candidature of any other degree.

Signature : .....

Name : Fatma Hermining Astuti

Date : April, 1st 2015

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Science in Manufacturing Engineering.

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DEDICATION

To:

My beloved mother and father

My lovely husband

My beloved sister, brother, niece, and nephew

ABSTRACT

This research was conducted based on a case study at an electronic manufacturing company that produces hard disc. Here, Kitting is the first step in assembly process. It is initiated well before the commencement of actual production to be able to prepare and deliver the material on time. Compound/Kitting section involves the provision of all the materials needed for a particular assembly process from the Warehouse and issuing the materials to the Assembly line. The Compound/Kitting section has been always crowded with high incoming materials (overflow) such that more spaces are needed to allocate the incoming materials. Therefore, the aim of this research is to minimize the overflow of incoming materials at Compound/Kitting section. Thus, three objectives are set: (i) to identify the overflow of incoming material at Compound/Kitting section and its implication to the performance of the subsequent production process, (ii) to analyze the demand changes patterns at production shop floor and its effects to the Compound/Kitting section and Assembly line performances, and (iii) to propose and evaluate the Flexible Lot Size for Kanban System to minimize the overflow of incoming materials. In this regard, Lean Manufacturing tools and techniques such as Value Stream Mapping (VSM) and Kanban system have been adopted to overcome the overflow of incoming materials. The constructed current VSM shows the lack of ordering system and the uncertain changes in demand cause to the overflow of incoming materials. Motivated by these factors, a Flexible Lot Size (FLS) for Kanban System is proposed to resolve the phenomenon. The FLS was modeled using simulation software. It begins by developing the current production simulation model that validated by the historical data of production input and output at Warehouse, Compound/Kitting section and also Assembly line section. In this study, the demand was classified into three categories: low, medium, and high. This research conclude that VSM is an effective tool to map the problems, while the FLS was able to provide the optimum Kanban number and lot size for the case of uncertain demand. In conclusion, a smooth production flow between Warehouse, Compound/Kitting section and Assembly line section can be sustained using the JIT concept “the right quantity at the right time”. In this way, the overflow of incoming materials at Compound/Kitting section has been decreased till 87.3 percent.

ABSTRAK

Kajian ini telah dijalankan berdasarkan satu kajian kes di sebuah syarikat pembuatan elektronik yang menghasilkan cakera keras. Di sini, Kitting adalah langkah pertama dalam proses pemasangan. Ianya dimulakan sebelum bermulanya produksi yang sebenar sehingga dapat menyediakan dan mengedarkan bahan pada masa yang tepat. Seksyen Compound/Kitting melibatkan penyediaan semua bahan yang diperlukan untuk proses pemasangan yang tertentu daripada Gudang dan mengedarkan bahan tersebut kepada Barisan Pemasangan. Seksyen Compound/Kitting sentiasa sesak dengan bahan-bahan yang masuk dalam jumlah yang berlebihan (overflow) di mana lebih banyak ruang yang diperlukan untuk memperuntukkan bahan-bahan yang masuk tersebut. Oleh itu, tujuan kajian ini adalah untuk mengurangkan limpahan bahan masuk di bahagian seksyen Compound/Kitting. Dalam kes ini, tiga objektif telah ditetapkan: (i) untuk mengenal pasti limpahan bahan masuk di seksyen Compound/Kitting dan implikasinya kepada pelaksanaan proses pengeluaran yang berikutnya, (ii) untuk menganalisis corak perubahan permintaan pada produksi shopfloor dan kesannya kepada prestasi di seksyen Compound/Kitting dan Assembly line, dan (iii) untuk mencadangkan dan menilai satu Sistem Kanban dengan Fleksibel Saiz Lot bagi mengurangkan limpahan bahan masuk . Dalam hal ini , alat dan teknik dalam Lean Manufacturing seperti Value Stream Mapping (VSM) dan sistem Kanban telah diterima pakai untuk mengatasi limpahan bahan masuk. VSM semasa yang dibina menunjukkan kekurangan pada sistem dan perubahan yang tidak menentu dalam permintaan menyebabkan limpahan bahan masuk. Didorong oleh faktor-faktor tersebut, Fleksibel Saiz Lot (FLS) untuk Kanban Sistem dicadangkan untuk menyelesaikan fenomena ini. FLS untuk Kanban Sistem dibangunkan dengan menggunakan model simulasi dan disahkan oleh data sejarah input dan output di Gudang, seksyen Compound/Kitting dan juga seksyen Barisan Pemasangan. Dalam kajian ini, permintaan diklasifikasikan kepada tiga kategori iaitu: rendah , sederhana, dan tinggi. Kajian ini menyimpulkan bahawa VSM adalah alat yang berkesan untuk memetakan masalah, manakala FLS mampu menyediakan jumlah Kanban dan saiz lot yang optimum untuk kes permintaan yang tidak menentu. Kesimpulannya, aliran pengeluaran yang lancar antara Gudang, seksyen Compound/Kitting dan juga seksyen Barisan Pemasangan boleh dikekalkan dengan menggunakan konsep JIT iaitu " kuantiti yang betul di masa yang betul". Dengan cara ini, bahan melimpah yang masuk di seksyen Compound/Kitting telah berkurangan sehingga 87.3 peratus.

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CT	-	Cycle Time
DES	-	Discrete Event Simulation
eVSM	-	electronic Value Stream Mapping
FKS	-	Flexible Kanban System
FLS	-	Flexible Lot Size
HDA	-	Hard Disc Assembly
JIT	-	Just In Time
LM	-	Lean Manufacturing
MCS	-	Material Control System
NVA	-	Non Value Added
POK	-	Production Order Kanban
PPC	-	Production Planning and Control
QFD	-	Quality Function Deployment
SimVSM	-	Simulation based Value Stream Mapping
SMED	-	Single Minute Exchange of Dies
TKS	-	Traditional Kanban System
TPM	-	Total Productive Maintenance
VA	-	Value Added
Vs	-	Versus
VSM	-	Value Stream Mapping
WIP	-	Work In Process
WK	-	Withdrawal Kanban

LIST OF PUBLICATION

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CHAPTER 1

INTRODUCTION

1.1 Motivation

Presently, many companies are focusing their effort in implementing the philosophy "*today has to be better than yesterday*" towards achieving higher business efficiency, effectiveness and productivity for their respective companies (Saleh et al., 2012). In general, manufacturing companies have problems in their operation site or shop floor. These problems can be unique where it is specific to a company or general problems such as high waste, low utilisation, high inventory, and over production. As organizations have struggled to remain survive and achieve economic sustainability, manufacturing company must always try to minimize their problems from time to time and improve their productivity.

According to Gershwin (2000) a manufacturing system is a set of machines, transportation elements, computers, storage buffers and other items that are used together for manufacturing. People are also part of the system. Alternate terms of manufacturing system are factory, production system and fabrication facility. Subsets of manufacturing systems, which are themselves systems, are sometimes called cells, work centers or work stations. The problems in manufacturing system, such as excess inventories, long lead times and uncertain delivery dates are caused by randomness and lack of synchronization. In this regard, there are two possible solutions: reduce the randomness (due to machine failures, engineering changes, customer demand and so on) and reasons for the lack of synchronization (costly set-up changes, large batch machines and others) or respond to

them in a way that limits their disruptive effects. Both responses are valid, but they can be, in practice polar opposites.

These problems can be addressed by performing some analysis to their current manufacturing approaches. Many have embraced Lean Manufacturing (LM) as a tool for continuous productivity improvement. LM is a systematic removal of waste by all members of the organization from all areas of the value stream. The value stream is defined as all activities that contribute to the transformation of raw material to end product including design, order taking, and physical manufacture (Womack et al., 1996). There are a number of benefits of LM implementation such as inventory and lead time reduction, quality improvement, and also flexibility enhancement. The practices of LM include 5 S, Kaizen, quick changeovers, Value Stream Mapping (VSM), and Kanban.

In this research, analysis will be done to evaluate current manufacturing approaches of a hard disc manufacturing company in Malaysia. Appropriate LM techniques will be used to identify and reduce or eliminate the apparent waste in their production system. In this way, the productivity can be improved.

1.2 Problem Statement

For hard disc assembly process in the company, different components are delivered from the suppliers arrive at the factory by truck. The components are unloaded into the warehouse area. From the warehouse, trolleys set off according to a schedule from the planner, delivering the components to Compound section and collecting the empty trolleys in the Compound section, then bring back to the warehouse and refilled for the next delivery. In this regard, Compound/Kitting section performs as an intermediate storage that collects the materials supplied directly from Warehouse and issues the materials to the next Assembly lines section. However, it was found that the Compound/Kitting section has a problem of overflow of incoming materials. It is always crowded with high incoming

materials even though the materials are pulled out almost every hour. As a result, 75% of the spaces in the Compound/Kitting section have to be used to store the excess material.

1.3 Research Questions

Based on the problems mentioned above, the main research questions of this study are as follows:

i. What is the current status of material flow in Warehouse, Compound/Kitting section and Assembly line section (i.e. current production lead time)?

ii. Do the demand changes in production shop floor affect the Compound/Kitting and Assembly line performance (i.e inventory level, actual production output quantity)?

iii. How to minimize the overflow of incoming materials in Compound/Kitting section, that caused by the gap between actual production output and planned demand quantity?

1.4 Research Aim and Objectives

The aim of this research is to minimize the overflow of incoming materials. In the mean time, a smooth material flow with a very minimum level of WIP inventory at the Compound/Kitting section can be achieved. Thus, the objectives of this research are:

i. To identify the overflow of incoming material at Compound/Kiting section and its implication on the performance of the subsequent production process.

ii. To analyze the changing demand patterns of the production shop floor and its effects on the Compound/Kiting section and assembly line performance.

iii. To propose and evaluate the Flexible Lot Size for Kanban System to minimize the overflow of incoming materials at Compound/Kitting section.

1.5 Research Scopes and Limitation

This research is based on a case study at a hard disc manufacturing company located in Malaysia. The study focuses on the high WIP of incoming materials at Compound/Kitting section. In this case, the concept of 'continuous flow' of Lean Thinking is adopted to solve this high WIP of incoming materials. Appropriate Lean tools and techniques such as Value Stream Mapping (VSM) and Kanban system will be applied to the production system at Compound/Kitting section.

This study selects only one product family, that is the T product family as it comprises 87% of the customer demand. Thus, class A inventory items of product T family will be studied as it presents high usage in the hard disc assembly process. The class A items are MBA, MEDIA, and HAS. These items contribute to high inventory cost in term of high WIP that consume large space at Compound/Kitting section.

1.6 Expected Outcome

The expected outcome of the study is the minimization of incoming material overflow at Compound/Kitting section. In addition, through the VSM tool, production wastes at every sub-process in the Compound/Kitting section could be identified and later eliminated. The proposed Flexible Lot Size for Kanban System would be able to provide a smooth material flow between Warehouse, Compound/Kitting section and Assembly line section with minimum WIP inventory.

1.7 Research Contributions

This research contributes to new knowledge for hard disc assembly process in the aspects of:

i. Clarification of the gaps between the planned demand and actual production output.

ii. Identification of the effects of changes in demand volume to the Compound/Kitting performances.

iii. Development of Flexible Lot Size for Kanban System that will be able to minimise the overflow of incoming materials at Compound/Kitting section.

1.8 Thesis Outline

This thesis is organized in six chapters. The topics addressed in each chapter are as follows:

Chapter 1 presents background related to the subject of this study which is electronic manufacturing company. The problem statements are given followed by the aim and objectives of the study. The chapter provides a focus and limitation in order to define the scope and to outline the study. The expected result and benefits of this study are also explained in this chapter.

Chapter 2 the literature review provides an extensive review of the existing literature on the challenges faced by electronic manufacturing company, LM system, and simulation study. The problems faced by electronic manufacturing company are reviewed in the early stage. The chapter then seeks to identify the philosophies and core principles of LM followed by the different tools, approaches and techniques of LM. Next, the theories of simulation derived from the literature review, as an aid tool in adopting the LM system to solve the company's problem.

Chapter 3 consists of explanation of the research methodology used in this thesis. The method is mentioned and reasoned as well as the strategies exploited in this study. In addition, the required data and details in data collection are also mentioned in this subchapter.

Chapter 4 explains the development of FLS model for Kanban system. In this chapter, the key components and the mechanism to develop the models are described in detail.

Chapter 5 presents the result that was acquired through the research methodology and model development explained in previous chapter. This chapter also provides the analysis and discussion of the result gained.

Chapter 6 In this chapter, summary of research findings are presented and the answer to the research objectives is clarified. Moreover, the direction for future research is given in the last subchapter.