UNIVERSITI TEKNIKAL MALAYSIA MELAKA

REDESIGN AND EFFICIENCY ANALYSIS OF SMALL SCALE PRODUCTION LINE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotics and Automation) (Hons.)

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2014

ABSTRACT

This project is about redesign and efficiency analysis on a small scale production line. The analysis was conduct by comparing the existing project with the after improvement project. By using Statistical Package for the Social Sciences (SPSS) software, the purpose of this analysis is to produces the efficiency of small scale production line which is stamping process through several improvement. Before making any improvement on the existing project, data is collected regarding production time in one cycle depend on weight of workpiece. This data was compared to the data after improvement. The purpose for redesign the project is to improve the performance of the existing project because there are several weakness on the mechanical, software and hardware part that effected to the production time. Furthermore, in real industrial production line, the production time is the important element to increase the productivity of company. That is how the industrial company gain the profit. There are some issue regarding to conveyor belt in the existing project. The conveyor belt was sag on the certain weight and immediately stop the conveyor. To overcome this problem, the conveyor belt was replaced by different material to ensure the conveyor belt is not easily saged by heavy workpiece. However, this project is focus on the small scale of workpiece but still able to carry a maximum weight until 700g. The PLC programme was changed due to the additional input on the PLC. Programming in forms of ladder diagram is simulate using the software to make sure that the programming is working. This new small scale production line is suitable as a learning aid to expose students about the basic mechanism in a production line.

ABSTRAK

Projek tahun akhir ini berkenaan dengan mereka semula dan analisis kecekapan kepada talian pengeluaran berskala kecil. Analisis ini dijalankan dengan membuat perbandingan di antara projek yang sedia ada dengan projek selepas penambahbaikan dibuat. Dengan menggunakan perisian SPSS, analisis ini adalah untuk menghasilkan talian pengeluaran berskala kecil yang lebih cekap melalui beberapa penambahbaikkan. Sebelum membuat sebarang penambahbaikan pada projek yang sedia ada, data akan dikumpulkan dengan mengambil masa pengeluaran untuk satu kitaran bergantung kepada berat bahan kerja. Data ini akan dibandingkan dengan data yang dikumpulkan selepas penambahbaikkan dibuat. Tujuan mereka semula projek dilakukan adalah untuk menambahbaikkan keupayaan kerana terdapat beberapa kelemahan pada bahagian mekanikal, perkakasan dan perisian yang memberi kesan kepada masa pengeluaran. Selain itu, di dalam industri yang melibatkan talian pengeluaran, masa pengeluaran merupakan elemen yang penting untuk meningkatkan produktiviti sesebuah syarikat. Itu merupakan cara bagaimana syarikat perindustrian meningkatkan tahap keuntungan. Terdapat beberapa isu berkenaan dengan sawat penyampai pada projek yang sedia ada. Sawat penyampai telah mengendur apabila bahan kerja diletakkan di atasnya pada berat yang tertentu dan penyampai akan berhenti secara tiba-tiba. Bagi menyelesaikan masalah ini, sawat penyampai yang asal telah digantikan dengan menggunakan bahan yang berlainan untuk memastikan sawat penyampai tidak mudah mengendur di sebabkan oleh bahan kerja yang terlalu berat. Walaubagaimanapun, projek ini fokus kepada bahan kerja berskala

kecil, namun masih mampu untuk membawa bahan kerja pada berat maksima sehingga 700g. PLC program telah diubah kerana penambahan peranti input pada PLC. Pengaturcaraan adalah di dalam betuk rajah tangga yang disimulasikan menggunakan perisian untuk memastikan pengaturcaraan yang dibuat berjalan lancar. Oleh itu, projek ini mempunyai potensi untuk dipertingkatkan lagi ke dalam sistem pembuatan yang lebih kompleks. Talian pengeluaran berskala kecil ini adalah sesuai sebagai alat bantuan pembelajaran untuk mendedahkan pelajar mengenai mekanisme yang asas dalam talian pengeluaran.

ACKNOWLEDGMENT

I would like to thank you for all who have helped in completing this report. The special thank goes to my helpful supervisor Mr. Mohd Nazmin B. Maslan for his guide and willingness to share his knowledge. However, it would not have been possible without the kind support and help of my father Hj. Mohamad Bin Mohd Yasin and my mother Hjh. Siti Hawa Bte Ibrahim. Gratitude to my fiancee Mohd Lutfan B. Abd Latib for the support and sharing of knowledge and experience in the industry involving production line. Not forgotten to all my friend who has shared their ideas and opinion. I would like to extend my sincere thanks to all of them.

I am highly indebted to the Robotic and Automation division for their guidance and constant supervision as well as for providing necessary information regarding this project and also for their support in completing this report.

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CHAPTER 1

INTRODUCTION

1.1 Background

Manufacturing and assembly systems have to be flexible to adapt quickly to an increasing number and variety of products, and changing market volume. Basically, production line is a factory system in which parts or components of the end product are transport by a conveyor trough a number of different sites at each of which a manually or machine operation is performed on them without interrupting the flow of production. The system used in advance, many workers it takes to perform all operations in production starting from the beginning to the end of the completion process but after making the observation and study, as a result there are many human errors because they have a limit to do a job. Today's most production line in large industries use automated production line which run by a machine. This automated system is more efficient rather than previous system because machine can run in a long time period without fatigue so it will decrease production lead time. Automation system can reduce overall costs for a company and improve the quality of the product. The current project is an example of a production line is equipped with the important modules that should be included in a production line. All these modules work in producing or completion a product for most

of the production operations. In order to control the pneumatic system, it used Programmable Logic Controller (PLC) as a controller. These existing projects, as a learning kit which can help students learn and understand the system related to the industrial production line.

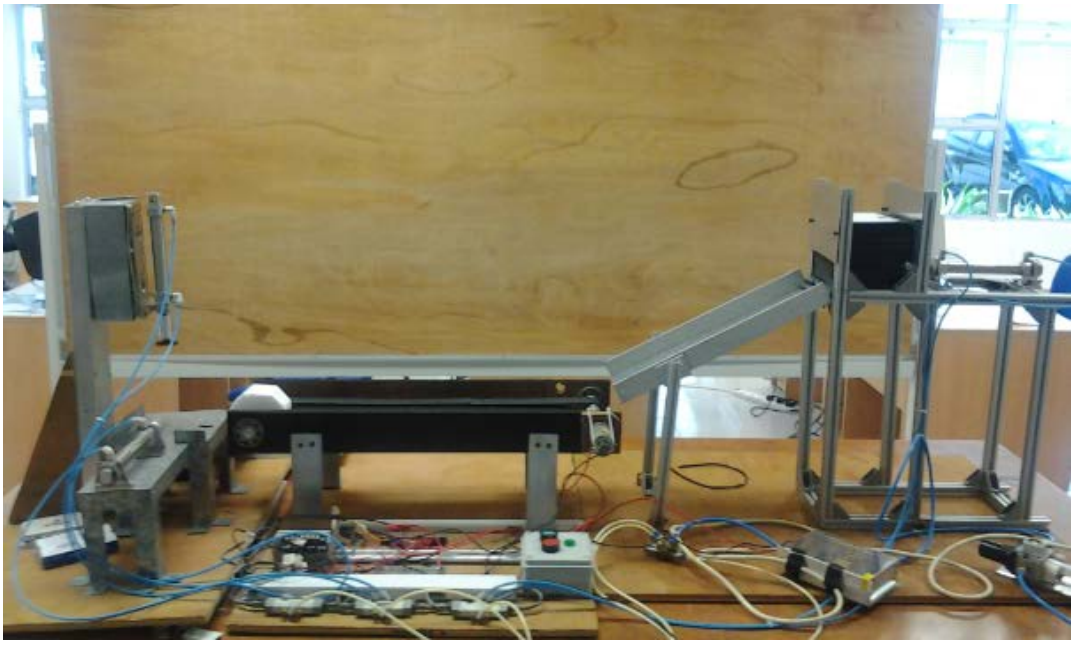

Figure 1.1: The existing Small Scale Production System

1.2 Problem Statement

In engineering, each project will be produced by the engineers need to emphasize on worker safety, maintenance, system inside to avoid the occurrence of unwanted things. With small scale production based on the existing system, students need to know more detail about the system and analyze the system's production. This is because, as a result of this analysis can produce more accurate answers through calculations were correct and appropriate use of statistical software in addition to practice what student have learned. In terms of programming, to produce the

best ladder diagrams and simple is important. There is nothing wrong in producing something that sets it apart is the only simple or complicated ladder diagram. A simple ladder diagram will facilitate e ngineers to identify and troubleshoot when an error occurs in the machine.

1.3 Objective

The main objective of this project is to redesign and conduct analysis on the small scale production line.

Several sub-objectives identified that must be achieved in order to make this project successful. There are:

1. To demonstrate pneumatic knowledge in a real automated system.
2. To apply statistical analysis to validate the optimization of the small scale production line.

1.4 Scope of Study

(i) The study of production system only involves the small scale production line in FKP UTeM.
(ii) The fluid power mechanism is limited to pneumatic system.
(iii) The analysis consists of the consumption to time for the production line to operate.
(iv) Analysis will be conducted by manipulating the weight of the workpiece.

1.5 Summary

This chapter is covering the introduction about the project. This project is to analyze the small scale production line which usually found in industries. The system operates using a pneumatic actuator; electric motor and reed switch that controlled by using Programmable Logic Controllers (PLC). Analysis is performed to obtain more accurate information concerning the operation of the small scale production line.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter shows the overview or act as a stepping stone about this project. Literature review give a solid background for this project report to facilitate supervisor to understand what are this project about, what are the mechanism, controllers or software used in this project, and how this project analysis might show the better result for evaluation.

2.2 Production Line

This point will describe on the history of the production line and its recent improvement from past ten years. The details included in this section are taken from journals and website.

In 1913, Ford Motor Company starts to the first mass production line for large scale manufacturing. As viewed in A Science Odyssey website

at http://www.pbs.org/wgbh/aso/databank/entries/dt13as.html, Henry Ford announced his goal for the Ford Motor Company in 1907 to create ‘ a motor car for the great altitude ‘. First model designing is Model T, a simple, sturdy car, offering no factory options, not

a choice of color but the Model T still not attainable for the “multitude”. This company thinks that they need more efficient way to produce the car in a lower price. Ford and his team do the research by looked at the other industries and found four principles are interchangeable part, continuous flow, division of labor and reducing wasted effort. By implement these four principles, the first moving assembly line was run. Ford produced cars at a record breaking rate. That meant the price getting lower but still makes a good profit by selling more cars. Ford manufacturing principles used by counter less other industry.

Figure 2.1: The assembly line was created in 1901 in order to keep up with the increasing demand for those newfangled contraptions and horseless carriages (Ransom E. Olds, 1901)

The concept of Lean Manufacturing starts at least in 18750 when Eli Whitney perfected the concept of interchangeable part. This concept can be seen in a Strategos website at

http://www.strategosinc.com/just_in_time.htm. Eli Whitney is best known as the inventor of the cotton gin. However, gin which is a small feat compared to the perfection of interchangeable parts. Whitney has built it in 1799 when he had a contract with the U.S. Army to produce 10,000 muskets at a very low price of $ 13.40 each.

According to 8th Grade Manufacturing website (http://www.wausau.k12.wi.us/horacemann/teched/Lean_Production_bomber_per_hr.htm) in January 1940, effected from the Second World War, the Roosevelt administration asked Ford Motor Company to manufacture parts for the B-24 liberator Bomber. Charles Sorensen tries to applied the Ford assembly method to airplane construction and turn out one four engine bomber and hour. The Ford Motor Company has been believed to produce bombers at an unthinkable rate on one per hour.

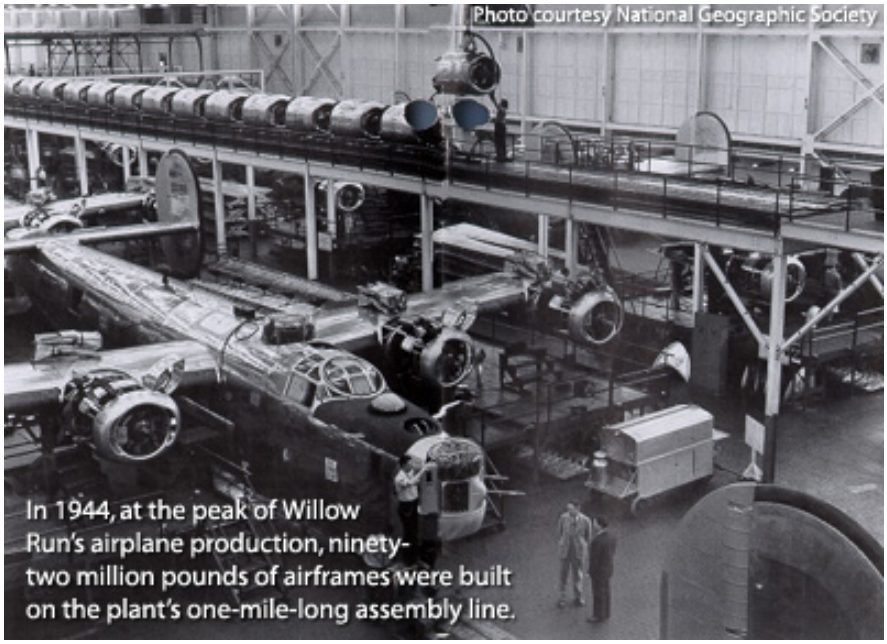

Figure 2.2: The Willow Run Bomber Plant which ninety two million pounds of airframes were built on the plant (Charles E. Sorensen, 1944)

In the past few years, many multinational industrial production lines are automatic. Automated assembly line consists of machines and run entirely by machine. Some full assembly line to be maintained by the machinery which consists almost entirely

automated self-control devices. These types of lines available in the industry with continuous process for example petroleum refining and chemical manufacturing plants in most modern car engine.

Current approaches to product/process design, improvement, and optimization have borrowed considerably from the principles of Taguchi. Taguchi and others working on these issues highlight an approach that puts emphasis on product/process variability, in contrast to traditional approaches that focused primarily on product/process location. According to Chinnam et al, (2000), they address the concept that products and processes lack quality because of performance inconsistency, regularly produced by factors that are uncontrollable in the design of the product or process. Consequently, in recent years, attention has been placed on the choice of a product/process design that is said to be resistant (robust) to these environmental or noise variables. Placement of the proposed on-line parameter design method on a reactive ion plasma etching semiconductor manufacturing process has shown the ability of the method to significantly improve product/process quality beyond current off-line parameter design approaches. In particular, the authors strongly believe that the proposed methods might be of great value in dealing with products/processes with low capability and many uncontrollable variables that have an effect on product/process output.

Developments in design methods for the 2-Line System Assembly and present the design approach to system management. Strategic management cost than lead time has been discussed by introducing matrix production schedule. Yamada and Matsui, (2003) states that the purpose of this invention form management approach is to provide a strategy for Assembly Lines position management system. This is to maximize profits by tweaking the assembly line management.

In the field of production management Automatic Line currently experiencing a lot of difficulty. This will become even more difficult when a fault or problem occurs online. In 2004, an artificial intelligence planning approaches have been proposed to facilitate this task. This is technique that was discussed by Ghariani and Lillie, (2004) and it has been proven to bring more quality to the configuration procedure. This is because it can

consider different types of knowledge, such as the availability of plant components, constraints between them and others.

For the production mix, different types of products have been manufactured by processing small lots at the same time. In 2005, a study was conducted to develop a simulation model for a mixture model production line. The study was done in a refrigerator. Arena simulation software was used to model production line in order to identify and assess barriers vacuum station. AGV performance, cycle times and production data have also been determined by the analysis software. The validity of this particular research method is discussed by (FB Armstrong et al, 2005)

The auto industry has been producing a wide range of products and experiences a lot of changes on the production line. Therefore, a major increase in demand for its products was also high and also to meet the good market. According to Li, Xie, Cui, & Principles, (2006), the best control system for the production line is proposed. The system is designed at the beginning of the rapid changes in the modular structure so that it can meet the production capacity and functions. This is to address all of the rapid change. System monitoring and data analysis has been achieved. The system was tested in SAAE Sdn Bhd and it shows increased effectiveness and efficiency of various products to suit different auto and motor output.

The reduction of cost and time to market, the improvement of product quality, and an increased response to changing technology and customer requirements are all critical issues that companies must face to be competitive in today's markets. On 11th International Software Product Line Conference, Sellier et al. (2007) introduce Software Product Line Engineering (SPLE) and stated that this software is one approach to address these issues. MSI Company concluded that the deployment of SPLE has provided significant advantages which are reduction in development time, reduction in several of product across the product line, product evolution was better control, and product understanding by the different investors was improved and reduces the risk to lose knowledge.