Faculty of Manufacturing Engineering

RELAYOUT PLANNING TO REDUCE WASTE IN FOOD INDUSTRY THROUGH SIMULATION APPROACH

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RELAYOUT PLANNING TO REDUCE WASTE IN FOOD INDUSTRY THROUGH SIMULATION APPROACH

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DECLARATION

I declare that this thesis entitle “Relayout Planning To Reduce Waste In Food Industry Through Simulation Approach”is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not currently submitted in candidature of any other degree.

Signature : .....

Name : Muhammad Faishal

Date : August 17, 2015

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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.

Signature : .....

Name : Prof. Adi Saptari

Date :

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DEDICATION

To my beloved families:

My Wife, Son, Mommy, Daddy, Brother and Sister

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ABSTRACT

Layout planning is one of the most important factors that must be considered if a company wants to become more competitive particularly in the cost, delivery and quality. A good layout can streamline transportation directly influence the cost and delivery time. This research is based on case in a food company in Indonesia. This company produces snack. The characteristic of this production process is make to stock system with 24-working hours. From the observation of the production process, it indicates that layout planning is ineffective. This showed on long distance moved of items, high number of worker and low throughput as well. The aim of this research is to re-layout in order to improve throughput and also reduce number of workers and the distance. A conceptual model was developed to determine the experimental factors and responses of the system. To solve this problem, three alternative layout were developed by using MULTIPLE method. These alternative layouts were then translated and analyzed into operational models using the ProModel 6.0 Simulation Software. The results indicates an improvement of throughput by 15% for alternative 1, 28% for alternative 2, and 21% for alternative 3. And for the number of worker indicates an improvement by reduce worker 13% for alternative 1, 2, and 3. For the distance indicates an improvement by reduce distance 83% for alternative 1, 87% for alternative 2, 86% for alternative 3. Generally, alternative 2 give the largest improvement than other although need more expensive cost investment.

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ABSTRAK

Perancangan sesebuah kawasan merupahan salah satu faktor yang perlu dipertimbangkan sekiranya ingin mempunyai kelebihan berdaya saing dari segi kos, penghantaran dan juga kualiti. Kawasan yang baik boleh menyelaraskan pengangkutan dan secara langsung memberi impak terhadap kos dan juga tempo masa penghantaran. Kajian ini merupakan kes di dalam sebuah syarikat makanan di Indonesia. Syarikat ini menghasilkan makanan ringan. Ciri – ciri proses pengeluaran dalam syarikat ini ialah menghasilkan bagi memenuhi stok sepanjang 24 jam masa bekerja. Berdasarkan pemerhatian terhadap pengeluaran, dapat dikenalpasti bahawa susunan di kawasan pengeluaran kurang efisien. Dapat dilihat barang digerakkan dalam jarak perjalanan yang jauh, ahli pekerja yang sangat ramai dan juga kadar pengeluaran yang rendah. Objektif kajian ini adalah untuk menyusun semula kawasan pengeluaran untuk meningkatkan kadar pengeluaran dan mengurangkan bilangan pekerja serta jarak antara penghantaran. Satu konsep model telah dibina bagi mengenalpasti faktor – faktor experimen ban gerak balas sistem. Bagi menyelesaikan masalah ini, tiga alternatif susunan kawasan menggunakan kaedah "MULTIPLE". Alternatif susunan kawasan akan diterjemahkan dan dianalisis kepada model operasi menggunakan perisian simulasi "ProModel 6.0" Hasil kajian menunjukkan kadar pengeluaran meningkat sebanyak 15% bagi alternatif 1, 28% bagi alternatif 2, dan 21 % bagi alternatif 3. Bilangan pekerja juga dapat dikurangkan. Bagi alternatif 1, 2, dan 3 mempunyai kadar pengurangan yang sama iaitu sebanyak 13%. Bagi jarak pengangkutan pula, jika alternatif 1 digunakan, jarak dapat dikurangkan kepada 83%, 87% bagi alternatif 2 dan akhir sekali 86% untuk alternatif 3. Secara keseluruhan, alternatif 2 memberikan penambah baik yang lebih banyak barbanding alternatif lain walaupun memerlukan kos pelaburan yang tinggi untuk merealisasikannya.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Competition among industries is getting intense nowadays. Globalization not only makes the industry compete locally but also globally. Each industry is looking for its strength to be able more competitive. All industries compete not only on cost, time, quality, but also environmental impact and sustainability. Industry in general is an integrated system of people, equipment, material, information and energy makes the manufacturing process becomes more complex. There is a growing concern to improve the productivity, safety, and quality in the manufacturing system, however many industries neglect layout planning (Moatari-Kazerouni et al., 2014).

Layout planning is one of the most important factors that must be considered if a company wants to become more competitive particularly in the cost, delivery dan quality because a good layout that can streamline transportation directly influence the cost dan delivery time. Layout planing deals with the physical arrangement of various resources that are available in the system with increase the operating system performances as the objectives (Mahadevan, 2007). About 20% to 50% of total production time are spent on non-added value material handling activities (Tompkins et al., 2010). Material handling is to do with movement within the layout. Poor facility layout may results in high distance moved by items and time consumed, high work-in-process and hence high throughput time. Therefore, providing efficient and safe movement is important in planning the layout.

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According to Wild (2003), there are some reasons why the company needs planning the layout, i.e. enlarging or reducing existing departments, movement of a department, adding or removing a department, and also replacing equipment and adding new equipment.

Hence, good facility layout contributes some advantages to manufacturing system. There are reduction in material handling and transportation, work-in-process, movement made by workers, and also waiting time. Another advantages are improve the utilization of space, facilities and labor, increase the work method and hence reduce the production cycle time (Hiregoudar and Raghavendra, 2007). Moreover excellent facility layout contributes to reduce CO_2 emissions in the atmosphere, nearly half of which comes from building energy. Therefore energy efficiency in building can play significant role in reducing CO_2 emission, one of performance indicator that be considered is space layout planning (Mourshed et al., 2009).

1.2 Problem Statement

This research is based on case company in a food industry in Indonesia. This company produce snack, i.e. “Cracker”. It contains the mix of powder, garlic and other seasoning. The characteristic of this production process is make to stock system with 24-working hours. In this line, there are two types of product, i.e. Product A and Product B. These product types have sameprocess flows and processing time, but different shape, production volumes and seasoning.

Figure 1.1 below shows processflow in “Cracker” line production of XXX Food company. It consists of mixing process, blending process, grading process, frying process, seasoning process, packaging process, and then distributing process to customer. This research is concerned on mixing and blending processes.

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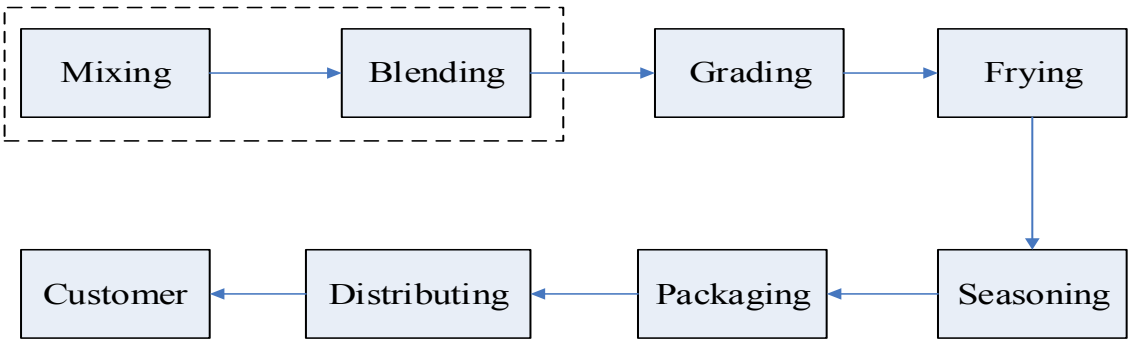

Figure 1.1Process Flow of XXX Food Company

From the observation of the the production process and discussions with the managers, plant supervisors and production line associates found that many problems occured in "Cracker" line. Mixing and blending processes are initial step in producing the products. The performances of both processes are the critical one for the next processes as these processes has the longest processing time and the most influence for the quality of the product. However, it was found that the layout planning was ineffective. The results showed has high distance moved by items, high number of workers, and low throughput as well. Table 1.1 below shows the current performances in real system. The number of throughput, number of workers, and total distance were 75 batches, 69 persons, and 4160 meter, respectively.

Table 1.1 Current Performances in Real System

Number of Throughput	Number of Worker	Total Distance
75 batches	69 persons	4160 meters

1.3 Research Questions

According to problem statement above, the problems formulated could be seen as follow:

i) What are the factors that have significant influence to troughput?

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ii) How does the scenarios-based re-layout planning affect to troughput?

1.4 Research Objectives

The aim of this research is to re-layout in order to improve throughput and also reduce number of workers and the distance as well. In more details the objectives are:

i) To investigate the various factors that affect to troughput.

ii) To develop the scenarios-based re-layout planning in order to improve troughput.

iii) To design and develop the simulation technique to evaluate the scenarios.

1.5 Research Scopes

To ensure the objectivesare achieved, some of the important elements must be considered. Thereare:

i) This research is based on case study in XXX Food Company in Indonesia.

ii) The company produces snacks, this study only investigating one of the product is“Cracker” with considering some different tastes. “cracker” has the highest demand among other products in company.

iii) This research concerns on mixing and blending workstations.

1.6 Organization of Thesis

This project will be discussed in six chapters as follows:

Chapter 1 Introduction: In this section, the main points discussed are Introduction, Problem Statement, Research Questions, Research Objectives, Research Scopes, and Organization of the Thesis.

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Chapter 2 Literature Review: this chapter elaborate the current state of the art research and theory of layout planning, type of layout, layout planning in manufacturing, tools and approach towards assessing layout problem, simulation, food manufacturing system, and summary.

Chapter 3 Research Methodology comprises of research design and summary.

Chapter 4 Model Development consist of Introduction, Process Flow in Company, Conceptual Modeling, Model Data, Model Translation, Verification and Validation, and Number of Replications.

Chapter 5 Model Experimentation, Results and Discussion comprises Introduction, Model Experimentation, Simulation Model, Results and Discussion, and then Research Contributions

Chapter 6 Conclusion and Future Work explain the conclusions and the recommendations for the future research.

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CHAPTER 2

LITERATURE REVIEW

This chapter elaborates all the theories and current information regarding on the facility layout planning by reviewing several related papers or journals. Additional theories regarding simulation and food manufacturing system are described as well.

2.1. Layout Planning

Layout planning is employed to arrange the resources in a shop floor in order to achieve the most effective arrangement according to some considerations under certain constraints. According to Bozer (2010) the problem areas may involve on determining the location and shape of various departments within a facility. Therefore, an optimal solution will yield the most efficient layout based on certain measures. Thus, facility planning contributes to some extent of the profit and efficiency of company (Bozer, 2010).

According to Drira et al. (2007) layout is a design for the floor plan of the plant which illustrates the arrangement of facilities or working activities whereby these facilities are located within a particular area according to its functions. According to Amit et al. (2012), the facility layout of manufacturing consists of configuring the plant site with lines, buildings, major facilities, work areas, aisles and other pertinent features. Moreover, these elements are related to one another and are integrated to define the organizational goals, to establish an overall strategy for achieving these goals, as well as to develop a comprehensive set of plans to integrate and to coordinate organizational work. The objective is involved by calculating the layout arrangement as effective as possible with respect to the resources needed such as staff,

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equipment or materials by a company to carry out its production. Booty (2010) defines layout as a place where the work setting is designed to achieve the shortest stop-time and where work stations are positioned to be nearest to one another.

Layout planning is one of the most important to achieve efficient production system as it effects to production cost, cycle times, inventory and productivity performance. Poor arrangement of the resources in the plant area has significant effect to high production costs, high inventory, and longcycle times and also improve productivity performance. The better placement of resources, the better overall efficiency of operation and the lower total operating expenses (Bozer, 2010).

2.1.1. Problems in Layout Planning

Nowadays, almost all ofindustries have new challenges in designing the facility layout. In order to meet the fast-changing customer demand, company currently require to re-layout the existing shop floor layout design to update their operation system. Facility layout design for existing shop floors have the following characteristics: (1) the presence of existing facilities poses critical constraints; (2) the facility layout design task normally tends to be small-scaled, e.g. removing and adding number of machines; and (3) the criteria used are often ad-hoc, and specific to different tasks. Hence, company often arrange with a less optimal layout plan (Jiang and Nee, 2013).

The layout problems may arise due to variety changes and developments in the current manufacturing line. In addition, the plant layout might be stimulated in order to improve the organization performance or to achieve greater profit. The common problems that often occur in the plant layout are product design changes, new products, changes in production volume, cost reduction, poor working environment, replacing equipment and adding new equipment.

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Those problems lead to some effects to the company, such as high product cost, lead time and waste (Nahmias, 2009).

i) Product Cost

Product cost is a principal problem and difficult when the companies have variety of products and high production volume (Greg, 2007). Generally, some typical problems related to product cost are:

a. High material handling results in high transportation cost.
b. The costs of purchasing raw material, production planning, and sales are disproportionate with low production volume.
c. The labor cost is difficult to adjust to various order sizes.

ii) Lead Time

Lead time is the time required for moving a product from start until complete the production process (Nash and Poling, 2008). According to Martin (2006), the component of lead time includes order preparation time (setup), queue or waiting time, production process time, move or transportation time, inspection time, and idle time. Higher lead time increase operational inefficiencies that is usually seen as high inventory level (Monden, 2012). One of techniques to reduce the lead time is planning the layout of production process to facilitate the product flow (Bauer et al., 1994).

iii) Waste

According to Dury (2006), waste is anything that does not give any added value in producing the products. By eliminating waste, it means production time could be decreased and hence improve the organization performance. There are eight waste that is included as non-added value activities in the organization (Nash and Poling, 2008):

- Defect

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