Faculty of Manufacturing Engineering

PRODUCTION CAPACITY LOSSES ANALYSIS IN MANUFACTURING SECTOR: A CASE STUDY OF UAE DUCTILE IRON PIPES MANUFACTURING INDUSTRY

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PRODUCTION CAPACITY LOSSES ANALYSIS IN MANUFACTURING SECTOR: A CASE STUDY OF UAE DUCTILE IRON PIPES MANUFACTURING INDUSTRY

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DECLARATION

I declare that this thesis entitled ‘‘Production Capacity Losses Analysis in Manufacturing Sector: A case study of UAE Ductile Iron Pipes manufacturing industry” 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 concurrently submitted in candidature of any degree.

Signature :……

Name :…….

Date :…….

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 Manufacturing Engineering (Quality System Engineering).

Signature :……

Supervisor Name :…….

Date :…….....

DEDICATION

I would like to give a very special appreciation to my beloved family and friends for always been there in the time of need. Thanks for giving me continuous support in order for me to fulfill the needs of my Master Project. To my beloved parent and to my supervisor, Dr Mohd Shahir bin Kasim, and all my friends who have encouraged, guide and inspired me throughout the study process.

ABSTRACT

Production capacity is referred as the total throughput a company, machine or system can produce. Several production systems are around us in various sectors. In manufacturing sector, there are possibilities of production losses due to various factors. Downtime cases, machine or human errors, faulty equipment or traditional production system all are source of production capacity losses in manufacturing sector. The aim of this project is to conduct analytic study of production capacity losses in manufacturing industries. The project takes ductile iron pipes industry in United Arab Emirates (UAE) as a case study of the production capacity losses investigation. The research data were collected in two ways, the first one by getting the data from selected company in UAE by visiting the company and observing the process and recording the required data. The second way of data collection was through questionnaire distribution to the consumers who utilize the company products. The collected data were analyzed and investigated along with suggestion of the most appropriate capacity planning approaches. The proposed approaches aimed to reduce the company production losses and increase their throughputs to meet customers' requirements. Hence the objectives of this project were successfully achieved through analysis and investigation of production capacity losses in ductile iron Pipes Company in UAE. The proposed approaches in this project are effective and can be implemented in other industries to reduce their production capacity losses and enhance their production cycle.

ABSTRAK

Kapasiti pengeluaran dirujuk sebagai jumlah keseluruhan syarikat, mesin atau sistem yang boleh dihasilkan. Beberapa sistem pengeluaran di sekeliling kita dalam pelbagai sektor. Dalam sektor perkilangan, ada kemungkinan kerugian pengeluaran disebabkan oleh pelbagai faktor. Kes-kes masalah waktu, kesilapan mesin atau manusia, peralatan yang salah atau sistem pengeluaran tradisional semuanya merupakan sumber kerugian kapasiti pengeluaran dalam sektor perkilangan. Tujuan projek ini adalah untuk menjalankan kajian analitik tentang kehilangan kapasiti pengeluaran dalam industri perkilangan. Projek ini mengambil industri paip besi mulur di UAE sebagai kajian kes penyelidikan kehilangan kapasiti pengeluaran. Data penyelidikan dikumpulkan dalam dua cara, yang pertama dengan mendapatkan data dari syarikat terpilih di UAE dengan melawat syarikat dan memerhatikan proses dan merekam data yang diperlukan. Cara kedua pengumpulan data adalah melalui pengedaran kuesioner kepada pengguna yang menggunakan produk syarikat. Data yang dikumpulkan dianalisis dan disiasat bersama dengan cadangan pendekatan perancangan kapasiti yang paling sesuai. Pendekatan yang dicadangkan ini bertujuan untuk mengurangkan kerugian pengeluaran syarikat dan meningkatkan keupayaan mereka untuk memenuhi keperluan pelanggan. Oleh itu, matlamat projek ini berjaya dicapai melalui analisis dan penyiasatan kehilangan kapasiti pengeluaran dalam Syarikat Pipa besi mulur di UAE. Pendekatan yang dicadangkan dalam projek ini adalah berkesan dan boleh dilaksanakan dalam industri lain untuk mengurangkan kerugian kapasiti pengeluaran mereka dan meningkatkan kitaran pengeluaran mereka.

ACKNOWLEDGEMENTS

First and foremost, I would like to take this opportunity to express my sincere acknowledgement to Dr. Mohd Shahir Bin Kasim from the Faculty of Manufacturing Engineering Universiti Teknical Malaysia Melaka (UTeM) for his essential supervision, support and encouragement towards the completion of this thesis. Special thanks goes to my university mate Eng. Nabil Al-Farah for his excellent cooperation and assistance in completing this master project. Another gratitude goes to my beloved mother and father for their prayers, support and encouragement.

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CHAPTER 1

INTRODUCTION

1.1 Background

Production capacity is referred as the total amount that a manufacturing operation able achieve. Production capacity to be increased in order to meet the current customers demand or expected increase in future demand. It is very important for companies to consider increasing their production capacity in order to suit customer requirement as well as increase the company profitability.

Nowadays industries are facing increasing materials and power costs that make an essential requirement to prevent any wastes in the production operation. Particularly companies in the simple and operation industry encounter this issue. Industrial institutions need to consider how they can methodically rise their production capacity. One of the methods which can enable companies to increase their production is based on the balanced scorecard method and enhances the changing operation to an effective production. This project focused in the managing and its related of the bottleneck because it is essential for an industry to enhance the production capacity cycle and to identify the weakness part in the production operation. In addition, each industry management prefer to generate an item at best quality involving fewer losses and to solve such problem is by having a planning regarding of efficiency of for suggested model. The primary gaol of this project is to investigate the production capacity losses in manufacturing losses considering UAE Company as a case of the project. Critical analysis and suggested approaches to be

implemented in order to maximize the producing capacity and reduce the production losses are presented.

1.2 Problem Statement

The production capacity in manufacturing industry can be referred as the capability of the industry to produce the required products or services to customers. Production capacity differs from company to another and machine to another as well. Due to production capacity losses and ineffective management, an industry production may not meet the customer requirement, hence leading to profitability losses and unreliability of the industries. Various factors can lead to losses in production capacity in a manufacturing organization. Hence, the aim of this project is to investigate the possible causes which might decrease the industry production capacity. In addition, suggested approaches and techniques are presented to help the industries increase their potential production capacity. A data collection of the manufacturing industry in UAE is obtained in order to investigate the possible production capacity losses as well as propose approaches in techniques which can enhance their production capacity and reduce the losses.

1.3 Objectives

This project aimed to study the production capacity losses in manufacturing industry considering Unites Arab Emirates manufacturing industry as the case of the study. Hence the following objectives are to be accomplished upon completion of the project:

i. To investigate potential production capacity losses in manufacturing industries.
ii. To propose bottlenecks analysis methods which can enhance the production capacity and reduce the production losses.
iii. To analyze the effectiveness of the proposed approaches which can lead into improvement in production capacity and minimize the production losses.

1.4 Scope of the Project

The scope of this research covers analyzing the possible production capacity losses in manufacturing industries considering UAE as case study. The data collection of manufacturing industries in UAE is done in order to investigate the production losses. The project cover proposing approaches and techniques which can help in reducing the production losses and increase the production rate. The effectiveness and capability of the proposed methods to enhance the production capacity are analyzed. Figure 1.1 presents the production system cycle.

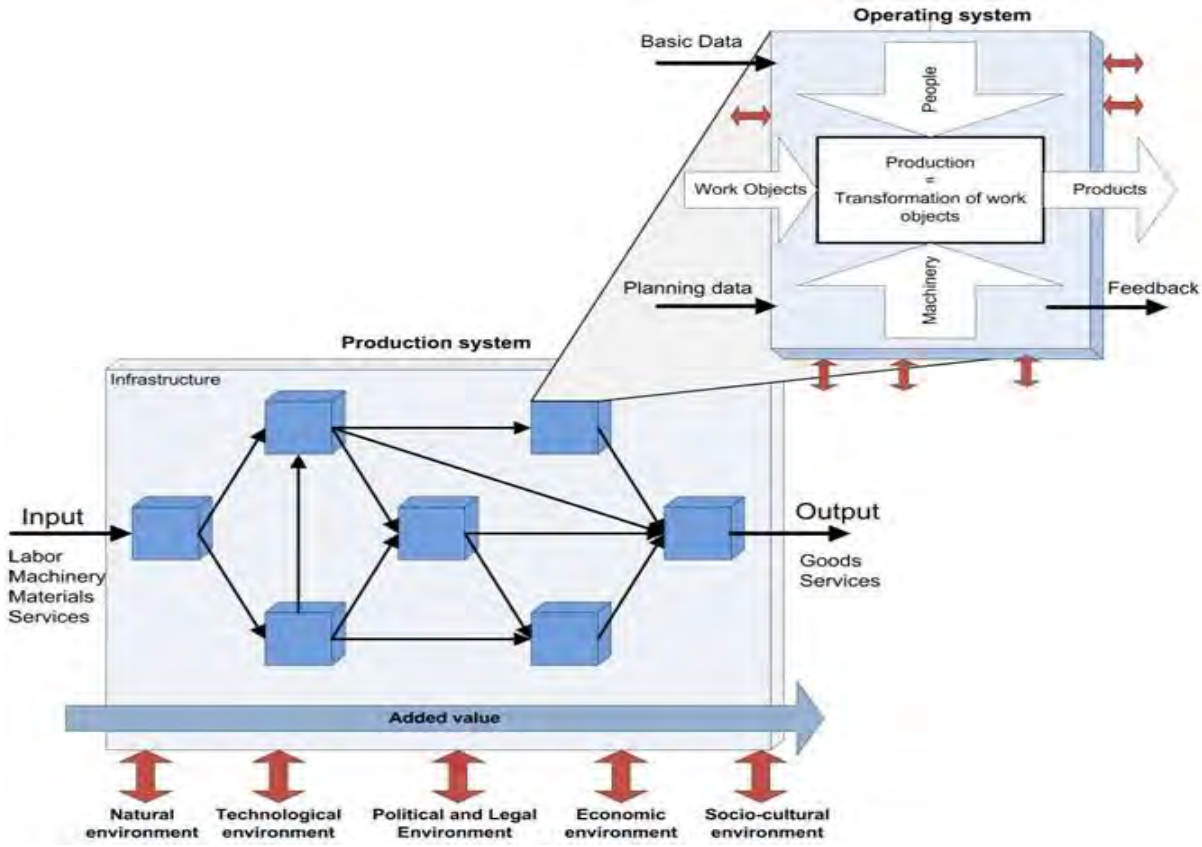

Figure 1.1: Production and operating system (Gram, 2011)

1.5 Report Outline

The project comprises fives chapter which are presented as follow:

Chapter 1: Introduction, this chapter gives a brief overview of the project background and formulates the problem of the research. The research scope, objectives and significance are discussed in this chapter as well.

Chapter 2: literature review, this chapter focus in presenting the related theoretical concept of the research. Available approaches and studies of enhancing the production capacity are discussed in this chapter.

Chapter 3: Methodology, data collection approaches and project sequence flow are presented in this chapter. A detailed explanation of the proposed approach and its implementation phases are described in this chapter as well.

Chapter 4: Results and Discussion, critical evaluation of the collected data and identifying the possible factors of production losses are presented. The effectiveness of the proposed methods is analyzed to determine their ability in increasing the production capacity.

Chapter 5: conclusion and recommendation, this chapter summarize the research finding and suggest some future implementation of the project as well.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Production capacity is the mount that manufacture operation can produce in order to fulfil requirement. This chapter analyse the production capacity and the methods which can obtain better production capacity in the industry. Moreover, capacity planning techniques are discussed in long and short-term planning method. In addition, some approached on how to obtain enhanced production capacity are presented. Apart from that, the overall equipment efficiency has been investigated as it is one of the techniques which can enable to enhance the production capacity. All other equipment and factors which have influence on increasing or decreasing the production capacity such as machines, labour etc. will be discussed in this report. The previous related studies of the research will be analysed in order to avoid drawbacks and propose new and effective approaches and methods which can lead in increasing the production capacity and reduce the production losses in a manufacturing industry.

2.2 Production Capacity

Capacity can be referred as the maximum output which a manufacturing operation can obtain in a certain period of time with the existed sources. Capacity is normally can be measured in production rates (e.g. 1,000 cars per month or 50,000 meals per day). Productive

capacity can be changed e.g. when equipment is undergoing of maintenance, the capacity is minimized. Capacity is connected to workforce planning: e.g. by working much production shifting, capacity can be maximized. In addition, capacity requires considering of seasonal or unexpected changes in demand (Heizer, 2016). Currently the organizations or industries encountering issues with their producing capacity by altering in capacity rating from one equipment to other equipment. Some equipment is getting their maximum production rate, however other are performing under the capacity planning rate. For this issue, it is crucial for industries to reduce the losses in the production operation and urgently emphasize that their production capacity rate is sufficient. Hence, production capacity level is increased in order to meet the current and anticipated customer's demands.

2.2.1 Capacity Planning

Naturally, capacity planning in general is strategic which include investments and, hence commitment in resources such as machines, facilities and labour. In light of this issue, capacity planning crucially has an influence into a numerous of organizational operations. These planning have numerous influences on the capability to meet the future requirements for the products which an industry is providing. Prices are largely affected by capacity planning as operating costs are bigger when there are investing in resources. In addition, the primary cost of the good is identifies by the unit cost that is usually derived directly from the costs of the capacity utilized. Other regions which are influenced are the simplicity of management; good capacity, simple to be managed, and competition of the industry. Such issues assure the requirement to plan these important decisions in advance. Capacity planning can be classified into three groups: Long-term, medium-term and short-term capacity planning (Smith, 2014), (Martínez-Costa, 2014).

2.2.1.1 Purpose of Capacity planning

The main point for an organization to perform plan capacity usage in advance is to match its supply competence and capability levels with the predicted demand by the customer. Capacity plan is formed to support the company's main competitive strategy and it has to be inline and correlate with it. The accuracy of the capacity plan is in sync with the company's ability to actualize their capabilities enabling them to have precise respond to the needs of the customer. Should the situation be so that the demand is too excessive, through a detailed plan it is easy to seek out the required steps which are to be done in order to satisfy the demand. Insufficient or otherwise inadequate capacity may turn out to be costly for the company as unpleased customers are lost and such a market attracts competition fasters (Kemal İlter, 2012).

$$efficiency = \frac{Actual\ output}{Effective\ capacity} \qquad 2.1$$

$$Utilization = \frac{Actual\ output}{Designed\ Capacity} \qquad 2.2$$

2.2.1.2 Long Term Capacity Planning

Long-term capacity planning is created in a time cycle of more than one year. Involving higher management participating, long-term planning focus productive sources that require long period to acquire and/or dispose. These sources involve for immediate facilities and equipment. Due to the attractions of these planning, they are to be achieved in the knowing of the external factors that might influence the planning. These items are markets, big competitors and PEST (political, economic, social and technical) environment. Figure 2.1 presents the relation of all of these factors (Jacobs, 2014), (Smith, 2014).Long-term capacity

planning is created to either increasing or decreasing the capacity. The reason behind this implies in the change of anticipated demand.

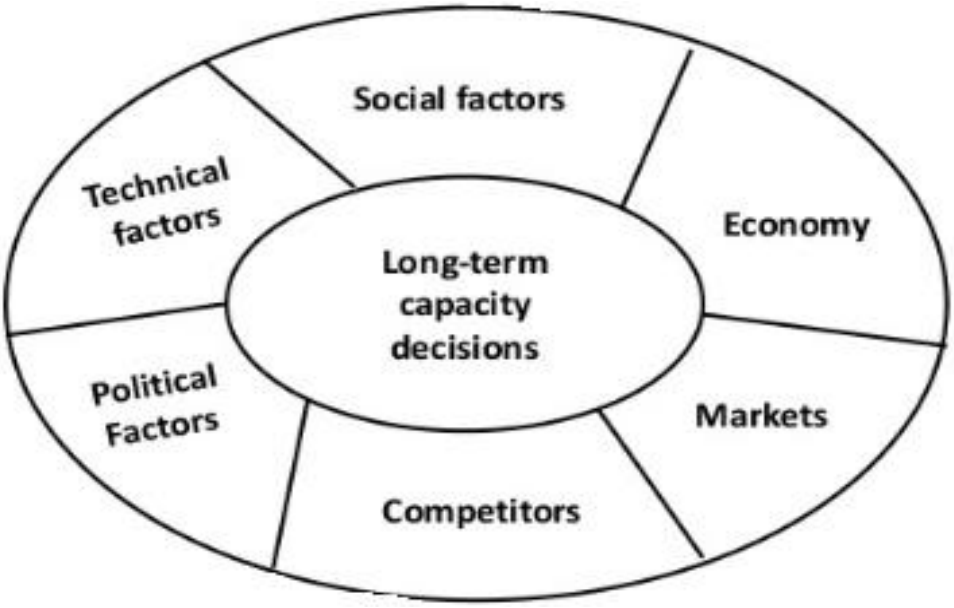

Figure 2.1: Long tern capacity planning (Smith, 2014)

2.2.1.3 Medium Term Capacity Planning

While long-term capacity planning can be treated as the macro perspective of capacity planning, medium-term consider of the micro view. The time cycle of medium term is 6 to 18 months. But, relying on the industry medium-term and short-term capacity planning do not possess an obvious separation but are achieved out while connected to each other. Hence, medium-term can involve time scaling as certain as weekdays. Planning created within this term is executed so that it can match the supply with requirement. To achieve this, the industry can either adapt the supply of sources or the requirement (Jacobs, 2014).

Adopting the requirement is largely complicated activity. Instance changes in requirement are somewhat can't be foreseen. Industry can try to illustrate requirement via marketing. Aggression commerce entices people in to utilizing more. Other activities to

influence the requirement could be two-for-one impacts at restaurants during a certain day of the week, which attempt to be lured in consumers when operations are normally slow.

2.2.1.4 Short-Term Capacity Planning

As discussed earlier, short-term capacity planning are highly connected to medium-term planning. The time scaling is less than one month. The planning might even be created for daily or weekly scheduling. Short-term capacity planning could be shown as fine-tuning of medium-term planning. The capacity, identified and acquired via medium-term plans, is created to suit the requirement by getting rid of the variance between planned and real output. The flexibility of the sources are taken to be tested here as instance changes in requirement needs fast execution movement via such means as employees overtime and other production routings (Jacobs, 2014).

2.3 Overall equipment effectiveness (OEE)

Overall Equipment Effectiveness (OEE) is a term developed by Seiichi Nakajima (Singh, 2013) to assess the way of effectiveness a manufacturing process is used. It is in accordance to the Harrington Emerson method of thought in regards of labour effectiveness. The outcomes are presented in a general frame that enables comprising among manufacturing departments in various organization. The machinery and equipment in the organization can achieve the task at 100% of the period providing better capacities and qualities, however if it attains to the reality it would be hard to operate over one 100 percent period, which reason of why OEE gets among the crucial element which able to assist of maximizing capacities, then minimizing the losses within company's operation. The requirement of OEE for offering an obvious data regarding of operation in a company, then provide a rated of forecasted

production period. The rates of the OEE outcomes are illustrated in Table 2.1 (Binti Aminuddin, 2016).

Table 2.1: Percent of OEE

OEE %	Production Condition
100	Perfect
85	Excellent
60	Fairly Good
40	Not Good

The basic method to compute OEE is as the rate of totally productive period to forecasted production period. Totally Productive period is just other method of stating manufacture just better products as fast as possible (typical Cycle period) without no Stopping period. Therefore, the computation is: OEE = (Good Count × typical Cycle period) / forecasted production period.

Even though here is the totally true computation of OEE, it does not give data regarding the three loss-related elements: Availability, Performance, and Quality. For this better computation is performed.

The parts of the (OEE) are:

i. Availability rate: it can be defined as the period, where the machine is operating divide by the overall working period.

$$\text{Availability rate} = \frac{\text{working period} - \text{downtime}}{\text{total working period}} \quad 2.3$$

- If the outputs is lower, thus downtime losses is produced

ii. Behaviour ratio: it presents the overall productions of the items generated with the possible production at maximum speed.

$$\text{Performance ratio} = \frac{\text{total output}}{\text{potential output at rated speed}} \quad 2.4$$

- If the output is lower, thus speed losses is produced.

iii. Quality ratio: the quantity of better output items over the overall production of the items generated.

$$\text{Quality ratio} = \frac{\text{better output}}{\text{total output}} \quad 2.5$$

If the output is lower, thus, defection losses in the model generated.

iv. The formula of the (OEE) computed as:

$$OEE\% = Availability\ rate \times Performance\ rate \times Quality\ rate \quad 2.6$$

2.3.1 Total Effective Equipment Performance (TEEP)

The TEEP computes the total machines efficiency proportional to planned period (24/7 period or 365/annually). TEEP outputs utilized to provide a possible capacity and presents the way the machine worked. The scheduled capacity is neglected in OEE, the TEEP concern on the crucial tasks like, scheduled maintenance stops, machines downtime, gathering and practices for team needs, creating of newly items, shifting plans and strategies for production. The distinguishing between the OEE and the TEEP is that the (OEE) compute the effectiveness in perspective of planned hours, but the (TEEP) depicts the effectiveness against the scheduled hours. (capstone metrics, 2012):

$$TEEP = Loading \times OEE \quad 2.7$$