MEASUREMENT OF PRODUCTIVITY RATE OF DRAINAGE TRENCH
EXCAVATION USING LEAN STRATEGY

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DEDICATION

I dedicate my work to my family and friends. A special

feeling of gratitude to my loving parents,

whose words of encouragement and push for tenacity ring in my ears.

My sisters, who never left my side and very special to me.

I also dedicate this research to my friends,

who have supported me throughout the process.

I will always appreciate all they have done.

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ABSTRACT

Productivity in construction industry is the ratio of output over resources that determine the outcome of product. LEAN is the principle used by the manufacturing industry to improve their product. This research apply the measuring productivity principle used by the manufacturing industry on machinery to measure the productivity of drainage civil construction activity. Hence, it aims to evaluate the quality of the constructed drainage base on the measured productivity outcomes. In this study, Time Cycle analysis is used to measure the productivity of a backhoe machine used for trench excavation and the labour productivity rate to install the drainage is also measured. Additionally, Cycle Time Tracking & Variance Analysis model are use to analyse the data obtained. The research targets a construction of drainage around Johor Bharu as a case study. The significant of study is to measure the optimum productivity rate of drainage construction. The optimum productivity rate for excavation is 3.59meters per hour with the quality of 4.2 out of 5, while the productivity rate to install the culvert is 8 pieces per hour with the highest quality of 4 out of 5. Productivity measurement can improve the overall construction performance in the construction.

ABSTRAK

Produktiviti dalam industri pembinaan ialah nisbah output ke atas sumber yang menentukan hasil produk. LEAN adalah prinsip yang digunakan oleh industri perkilangan untuk meningkatkan produk mereka. Kajian ini menggunakan prinsip produktiviti pengukuran yang digunakan oleh industri pembuatan pada mesin untuk mengukur produktiviti aktiviti pembinaan saliran saliran. Oleh itu, ia bertujuan untuk menilai kualiti asas saliran yang dibina pada hasil produktiviti yang diukur. Dalam kajian ini, analisis Kitaran Masa digunakan untuk mengukur produktiviti mesin Jentolak yang digunakan untuk penggalian parit dan kadar produktiviti buruh untuk memasang saliran juga diukur. Di samping itu, model Pengesanan Masa & Analisis Analisis Kitaran digunakan untuk menganalisis data yang diperolehi. Penyelidikan ini mensasarkan pembinaan saliran di sekitar Johor Bharu sebagai kajian kes. Kajian penting adalah untuk mengukur kadar produktiviti optimum pembinaan saliran. Kadar produktiviti untuk penggalian adalah 3.59meter sejam dengan kualiti 4.2 daripada 5, manakala kadar pemasangan saliran pula adalah 8 biji sejam dengan kadar kualiti 4 daripada 5. Pengukuran produktiviti dapat meningkatkan prestasi pembinaan keseluruhan dalam pembinaan.

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INTRODUCTION

1. 1   General

According to Motwani (1995), productivity measurement in construction industry is important for the sector to continuously improve thier performance and compete within their sector. The practical approach to measure the productivity within construction industry is needed to be identified. There are several model that can be used to measure productivity in construction such as Time Cycle Analysis. However, this research focus on LEAN strategy that currently being used in manufacturing industry to measure their productivity. Hence, LEAN have been used by the manufacturing sector to improve their product performance and quality. In this project, LEAN strategy to measure productivity will be implement in construction industry.

1.2   Background Of Study

According to Krugman (1994), productivity rate is the number of product can be produce by the time given. Hence, Chia (2012), mention that productivity have great influence on national economic growth. Measuring the construction industry productivity will also reflect toward the measurement of the industry economic growth itself. In construction planning and scheduling, it is necessary to know the production rate for specific activity to estimate the period for the task completion.

LEAN thinking mostly implemented in manufacturing industry for improvement in the industry in terms of production involving machinery. Construction industry partially manual trade and equipment to facilitate each construction activities. Plant and equipment require a proper management to utilize their maximum potential and to operate according to the plan and scheduling of a project. Thus, excavation activity involves several types of plants to facilitate the process. The example of common plant been used for excavation activities are excavator and backhoe. This research focus on measurement of productivity for drainage trench excavation, involving the use of backhoe as machinery and manual labour productivity to install the drainage pre-cast.

This research focus on the measurement of productivity rate in construction of V-Shaped Trench Drainage activity. The activities for V-Shaped drainage construction are identified and the productivity rate for each activity is measured.

1.3   Problem Statement

According to Chau (2003), researches of construction productivity have problems in measurement and availability of data. This issues is reflect toward the challenge of indentifying the factors affecting the level and growth of efficiency in construction industry. Thus, according to Motwani (1995), identifying the critical factors that influence the productivity in construction industry is a challenge. In addition, according to Noh (2014), higher productivity rate reduce the quality of product. This research intends to use the LEAN principle used in manufacturing industry to measure their productivity and evaluate the quality. This process will determine the quality of product at a certain rate. This research will measure the productivity rate on drainage activities with specific indentified critical factors that influence the productivity and act as constant variables.

According to Sambasivan (2006), labour and equipment related to productivity contribute to causes of delay in construction project. Hence, according to the research, labour and equipment was ranked 3 out of 8 categories of delay causation in Malaysia construction industry. Hence, the quality of work and the productivity among the workers in Malaysia, have significant impact on project progress and efficiency. This will eventually result in delay on completion sequence, where the successor activity will be affected and causing delay for the entire project.

1.4   Objectives and Aim

This study aim is to measure the productivity of drainage trench excavation. To achieve the aim, the objectives are:

i.   To measure the productivity rates of trench excavation using plant (Backhoe) using Time Cycle Analysis

ii. To calculate the optimum manual labour productivity rates to install V-Shaped Trench Drain using Activity Oriented formulation.

iii. To evaluate the quality of finished drainage construction base on the drainage construction productivity rates.

1.5   Scope of Study

The research purpose is to determine the productivity rate of drainage construction activity using LEAN principle. This research focus on the construction of V-Shape Trench Drain activity. The activity for construction of V-Shaped drainage is identified. Each activity will be measure its productivity rate. Hence, the quality of the finish product will be evaluated.

The variable for productivity rate will be scope to specific resources and act as a constant variable. The constant variable this research is plant, materials and number of labour. In addition, each resource variable will be selected according to common resource generally being used in Malaysia construction activity.

1.6   Significant of Study

Measuring the productivity within construction industry will improve the construction process. The study aim to provide useful information regarding construction productivity for a specific activity. The research measure the productivity of drainage work for precast drainage. The activities measured include the excavation process and the installation process.

The measurement for the excavation process involve the specific plant chosen that suit the activity. Pratt (2010) mentioned the suitable machine for trench excavation in backhoe, due to its mobility. The research measure the productivity of a backhoe to excavate trench drain. The result can be use as standard efficiency for backhoe to excavate trench drain.

Measuring labour productivity will determine the optimum productivity rate for drainage installation. The productivity rate is influence by the total man-hours, which the result will determine the standard rate of productivity to install drainage within one hour.

Hence, this research will also clarify the problem statement on the higher the productivity rate, the lower the quality produce. The result of productivity will then be evaluated towards its quality. This is to measure the quality of product at a certain productivity rate. Hence, this result can be use to improve the quality of drainage work with respect to time taken to complete the work process.

1.7   Research Structure

The main purpose of this research is to measure the productivity of drainage trench excavation and measure the quality of drainage base on the productivity rate. In order to achieve these objectives, the activities involving construction stage for drainage work is identified. Figure 1 shows the research process to achieve the final objective for this research.

Drainage Productivity	Trench Excavation	Labour Productivity	Quality Assesment
• LEAN Princple	• Variance Analysis	• Activity Oriented Model	• JKR Draiange Work Specification

Figure 1.0: Research Process
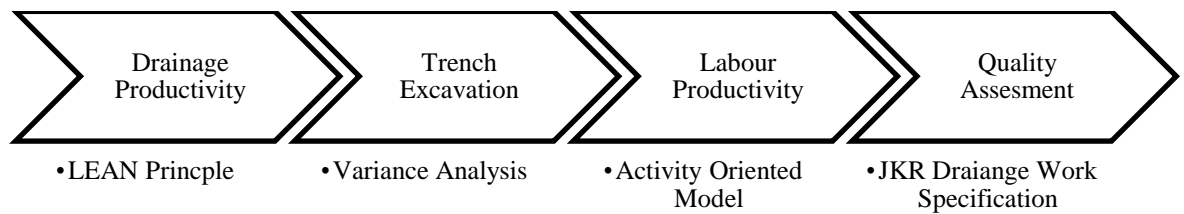
Collecting data of the research will require several procedures. The first data is regarding the first objective, to measure the productivity rates of trench excavation using backhoe with Time Cycle Analysis, is a primary data collection. The information gathered through measurement of backhoe excavation for specific drainage activity on site. The data will be analyzed using SPSS.

Second objective also use the primary data collection method, which is to measure the labour productivity rates to install V-Shaped Trench Drain using the Labour Productivity Rate Activity Oriented Model formula:

$$\frac{Unit\ of\ Output\ (Length\ of\ Drainage\ Intall)}{Unit\ Of\ Labour\ (Man\ Hours)} = Labour\ Productivity\ Rate$$

The third objective is to evaluate the quality of drainage base on the drainage construction productivity rates require the result gathered through first and second objective. The evaluation will rated based on the standard JKR standard specification 2014.

1.8   Summary

Productivity measurement is important in construction industry to improve their performance. Hence, it can be use as key performance indicator, measuring the output of performance for a specific task in the industry. The problem statement is resolved through achieving the objectives of this research.

The first objective is to determine the productivity rates of trench excavation of a backhoe. This objective is achieve by measuring the performance of backhoe excavating a trench on sites, thus, implanting LEAN strategy to measure the productivity rate.

The second objective is to determine the optimum labour productivity rates to install V-Shaped Trench Drain. This objective is achieve by measuring the total man-hours to install the V-Shaped Trench Drain per-hour by using Activity Oriented formula.

The third objective is to determine the quality of the drainage manage to achieve through the productivity rate of both machine and labour productivity. This objective is achieve by evaluating the quality of the final product after the installation of V-Shaped Trench Drain completed.

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