ANALYSIS OF ROVER SYSTEM ON PRODUCTIVITY AND RETURN ON INVESTMENT IN AGRICULTURE

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DECLARATION

I declare that this thesis entitled “ Analysis of Rover System on Productivity and Return on Investment in Agriculture” results from my own research except as cited in the references. Therefore, the thesis has not been accepted for any degree and is not concurrently submitted in the candidature of any other degree.

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APPROVAL

I hereby declare that I have read this thesis, and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours.

Signature : ______________________________

Supervisor Name : Nur Aiman Hanis Binti Hasim

Date : 15 January 2022

DEDICATION

To my beloved family and friends who have been my source of strength and inspiration and gave me support in terms of moral, spiritual, and emotional.

To my supervisor Madam Nur Aiman Hanis Binti Hasim for guiding and supporting me in completing this thesis. Also, to my co-supervisor Madam Nur Farah Bazilah Binti Wakhi Anuar for giving me every possible solution needed.

ABSTRACT

Agricultural sectors are now in the process of facing either an increase or decrease when it comes to the rate of productivity. By simply implementing the rover system can be beneficial in that it affects drastic change in productivity and return on investment. Productivity is a critical issue in the agriculture sector that must be addressed in order to increase key performance indicators such as production and efficiency. Despite the fact that the agricultural system exists in our country, it still has problems with production, which does not meet the expected output. The aim of this research is to identify the factors that affected productivity performance and return on investment. Hence, to apply the Define, Measure, Analyse, Improve, Control (DMAIC) concept in agricultural performance and to recommend a solution to the industry for productivity improvement and performance. There are few tools that are used in order to complete this study. In order to obtain the outcome for this initiative, data were gathered and problems were identified. Data processing can be divided into two categories which are primary data and secondary data. The methods utilised to identify the underlying causes were the Fishbone Diagram and the Why-Why Analysis. Furthermore, the implementation of six sigma tools was approached as the DMAIC method enabled the work to be more effectively completed. The findings of this data were then tabulated using the Why – Why Analysis to identify a root cause remedy. The operating model system provided an efficient way to understand the process of the agricultural system. Then, the application of the Maynard Operation Sequence Technique (MOST) approach was to evaluate the working time and work process of the sectors as the work measurement technique produced sequence model for the complete activity. As such, the changes in the work process brought a valuable change in productivity and benefits in return on investment in such a way. Aside from that, the agricultural sector were to be advised to engage in optimization and improvement activities from minimising or removing factors that affect productivity utilising the MOST methodology. All analysis and root cause identification must be performed before results can be obtained. It has been discovered that a particular error involving human error needs to be removed from the process in order to increase productivity. As a result, a few potential alterations are described and suggested in this study. One of the most effective ways to boost output and save expenses was to deploy a rover system. Robotic rovers save time and money over manual labour, according to the study. Robotic rovers' ROI is 18.45% higher than manual labour.

ABSTRAK

Sektor pertanian kini dalam proses menghadapi peningkatan atau kekurangan dalam tingkat produktiviti. Dengan hanya melaksanakan sistem *rover*, ia dapat memberi manfaat kepada perubahan yang ketara dalam productivity dan *return on investment*. Produktiviti merupakan salah satu isu kritikal dalam sektor pertanian dan harus ditangani untuk meningkatkan prestasi utama seperti kecekapan pengeluaran. Walaupun sistem pertanian wujud di negara kita, ia masih mempunyai masalah dengan pengeluaran yang tidak memenuhi hasil yang diharapkan. Objektif kajian ini adalah untuk mengenal pasti factor-faktor yang mempengaruhi prestasi produktiviti dan *return on investment*. Selain itu, penggunaan kaedah *DMAIC* dalam prestasi pertanian dan mencadangkan penyelesaian kepada sektor pertanian demi meningkatkan produktiviti. Terdapat beberapa kaedah yang digunakan untuk menyelesaikan kajian ini. Demi untuk mendapatkan hasil dari daya usaha ini, data perlu dikumpulkan dan masalah yang wujud perlu diambil kira. Perlaksanaan *Six Sigma Tools* sebagai kaedah *Define, Measure, Analyse, Improve, Control (DMAIC)* telah dijalankan matlamat kajian dengan lebih berkesan. Penemuan data ini kemudian diggunakan secara Mengapa – Mengapa Analisis untuk mengenal pasti kaedah penyebab punca. Operasi sistem model menyediakan cara yang efektif untuk memahami proses sistem pertanian. Penggunaan teknik *MOST* adalah sesuai untuk pernilaian masa dan proses kerja dalam kalangan sektor pertanian. Dengan demikian, perubahan dalam proses kerja telah membawa peralihan yang berharga dalam produktiviti dan memberi keuntungan kepada *return on investment*. Hasil didapatkan selepas semua analisis disiapkan and punca utama yang mempengaruhi productiviti telah dikenalpasti iaitu kesalahan manusia yang terbabit dalam pengurangan produktiviti. Oleh itu, sektor pertanian disarankan untuk melibat dalam kegiatan penambahbaikan dan activiti peningkatan dengan mengurangkan atau menghapuskan factor yang mempengaruhi produktiviti menggunakan teknik *MOST*. Pelaksanaan *rover system* adalah salah satu penyelesaian untuk meningkatkan productivity serta menjimatkan kos. Analisis yang dilakukan membuktikan bahawa *rover system* lebih menjimatkan masa berbanding dengan kerja buruh dan pulangan pelaburan untuk *rover system* adalah 18.45% lebih berbanding dengan kerja buruh.

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LIST OF ABBREVIATIONS

MOST	- Maynard Operation Sequence Technique
ROI	- Return on investment
SPRS	- Smart Pesticide Rover System
QCC	- Quality Control Circle
TQM	- Total Quality Management
PFMEA	- Process Failure Modes and Effect Analysis
SPC	- Statistical Process Control
UCL	- Upper Control Limit
LCL	- Lower Control Limit
DFSS	- Design for Six Sigma
RCA	- Root Cause Analysis
DOE	- Design of Experiment
DPMO	- Defect Per Million Opportunity
OLS	- Ordinary Least Squares
GWR	- Geographically Weighted Regression
SROI	- Social Return on investment
AI	- Artificial Intelligence
NVA	- Non – Value Added
TDABC	- Time – Driven Activity – Based Costing

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CHAPTER 1

INTRODUCTION

1.1 Research Background

There are various factors that influence construction labour productivity in Malaysia today. The facility's design determines its complexity and intricacy, which in turn influences labour productivity. A second distinction to make is between factors that influence productivity and those that only influence costs. It is the responsibility of management to provide the necessary tools, equipment, equipment, and information to the workforce in order for them to perform their duties in a workmanlike manner. An additional economic concern arises when productivity increases as a result of a change in job design, resulting in the worker's job being downgraded and his pay being reduced. As a result, the majority of farmers continue to use traditional methods and outdated machinery (William F.Maloney, 1983). As a result, productivity is low. Need agriculture institutional arrangement to farmers to educate them with short term courses or workshops to educate and update the latest methods and machinery in the hope that it will deliver results is quite common in the context of agriculture, as stated by Ch. Chandra Sekhar (2017). Techniques developed in advanced countries were not always directly transferable to less developed countries due to differences in climate and resource endowment. The principal sources of high productivity in modern agriculture are reproducible sources. They consist of specific material inputs as well as the skills and other capabilities required to successfully use such inputs (Vernon W.Ruttan, 2002).

There is never enough time or money to complete all worthwhile tasks. When faced with a plethora of potential projects and limited funding, standard business and economic advice are to invest in projects with the highest rates of return on investment. According to William Murdoch (2007) whereas in conservation applications, Return on Investment (ROI) reflects the changes in the conservation objective per unit cost of the conservation action. Conservation actions might include land purchase, or easements, management of invasive species, fire management, pollution control, lobbying activities, conservation financing aimed at sustainable forestry, and so on. Protected areas are essential in efforts to conserve biodiversity and secure and focus on improving ecosystem services. Protected areas vary in many ways, and countries must ensure that newly established protected areas are ecologically effective. This includes ensuring that protection is targeted to areas where it is most needed and that protected areas are appropriately sized and adequately funded. As a result, any new protected areas must be chosen in a cost-effective and ecologically sound manner. Conservation organisations increasingly rely on return-on-investment (ROI) analyses to balance these demands. P.R. Armsworth et al. (2018) addressed that ROI approaches seek to identify candidate sites for protection that offer the greatest return, when measured in terms of the ecological goals motivating conservation, for every money spent on protection.

Manipulating pest infestations plays a vital role in increasing productivity. Farmers are having a difficult time dealing with pest infestations. The main disadvantage of this method is that the pesticide may come into contact with the farmer during spraying, which may cause skin cancer and asthma attacks. Increased pesticide spraying has the potential to harm consumer health as it enters the food chain. Pesticides are also sometimes sprayed on crops that are not affected, resulting in the same waste. By using the form of SPRS (Smart

Pesticide Rover System), produced a fresh concept of using IoT to monitor crops and to use intelligent farming (Dileep Kotte, 2020).

The primary objective of any work measurement technique is to reduce work content and thus improve process productivity; this is concerned with the intention to spread awareness of a specific work measurement technique known as the ‘Maynard Operation Sequence Technique (MOST). The stopwatch method would typically take forever for an Industrial Engineer who would be standing right behind the operator, observing and noting down the various actions. This, in turn, causes a slew of annoyances, deliberate delays, and the addition of non-value activities by the operator. The important challenge is that the worker/union believes the entire estimate is unfair. The MOST technique nearly eliminated the unpleasantness for workers (Vivek A. Deshpande, 2007). A manufacturing company's productivity is hampered by bottlenecks at workstations. As a result, bottleneck workstations and non-value-added activities are essential for achieving the company's goal. As a result, it is essential to identify and eliminate bottlenecks and non-value-added activities. The MOST can be defined as a method of analysing operations or sub-operations that are carried out using various methods, steps, and sequences, etc. In other words, it is a motion time method that aims to define the standard time of performing the work. As a consequence, increasing productivity through the smooth workflow is critical (Md. Sumon Rahman, 2018).

1.2 Problem Statement

In the past years, although the agricultural system exists in our land but yet it is still facing issues when it comes to productivity where the productivity does not reach the desired output. This can be caused by several factors when it comes labour or pesticide. This analysis aims for productivity improvement based on the MOST technique using the DMAIC concept in agriculture performance and calculation of ROI. Hence, the techniques will tend to improve productivity with ROI based on the factors in agriculture. When it comes to controlling the issues in pesticides, the rover system approach will come in handy as not much agricultural field uses this system to increase their productivity and reach the desired output.

This is applied so that the product will meet the desired output. Through ROI we can accumulate the return on investment as this is a field where a wide range of investment can be implemented. If the SPRS is introduced to the field, it aids the economic development of farmers and, by extension, the nation. Using this type of robot, the time spent spraying pesticide liquid is reduced, and it will also assist farmers in reducing their workload in any season or condition (Chaitanya et al., 2020). But in order for it to be successful, the solution has to be tested using the MOST technique as we can differentiate the current working method with the provided solution to produce a proper outcome and eliminate downtime.

1.3 Research Objectives

The main objective of this study is to enhance productivity performance through Rover System implementation in agriculture. The general objectives of this study are :

a) To identify the factors affected to productivity performance and ROI.

b) To apply the DMAIC concept in agriculture performance.

c) To recommend a solution to the industry for productivity improvement and performance.

1.4 Scope of Research

Particularly, this study will focus on the improvement of the production activities by using the tool MOST in the agriculture industry based on DMAIC (Define, Measure, Analysis, Improvement, Control) method. The crucial task of this study is to minimize or eliminate waste and controlling the smoothness performance of productivity through reduction of pesticide burst process time in agriculture. Hence, the application of ROI measures the gain and loss on an investment related to the amount of money invested as this should improve the decision-making process. This method is important to achieve timely delivery to customers also continuous improvement in the company.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

To make a long story short, the analysis of agriculture throughout the years has been an unstable record in productivity due to several kinds of factors that affected production. According to Ruttan (2002) in modern agriculture, the primary sources of high productivity are reproducible. They consist of specific material inputs as well as the skills and other capabilities required to successfully use such inputs. However, these modern inputs are rarely ready-made. In general, there is a body of knowledge that has enabled advanced countries to produce for their use factors that are technically superior to those used elsewhere. Time consumption is decreased in spraying the pesticide liquid and it will also assist farmers to lessen the burden and in any season and weather conditions to complete the task. Early detection and avoidance of pests are vital in crop management (Dileep Kotte, 2020). However, Armsworth et al. (2018) stated that conservation organisations are increasingly relying on return-on-investment (ROI) analyses to balance these demands. ROI approaches seek to identify candidate sites for protection that provide the greatest return for every money spent on protection when measured in terms of the ecological goals motivating conservation. Hence, manufacturing has been on a decades-long quest for increased productivity. As a result, a slew of technology advancements and productivity-boosting methods have arisen (Park & Li, 2019). This strategy has aided in the advancement of the operations management discipline by increasing productivity levels in practice (Güldenpfennig & Hansen, 2021).

2.2 Six Sigma

Lean manufacturing is a methodology that assists businesses in continuously eliminating waste (for example, overproduction and waiting time), whereas Six Sigma is used to reduce variation in processes with the ultimate goal of improving quality production and performance. It is one thing to successfully implement quality tools; this is quite another to choose which quality tools will significantly improve the organisation's performance. One of the most difficult aspects of implementing quality tools in the Lean and Six Sigma methodologies is examining which tools are most effective in improving overall operational performance (cost reduction, productivity, and quality). This is because not all high-quality tools are required for a specific project (Cohen et al., 2020).

There are so many solutions to production problems and retrofitting manufacturing technology, such as the Quality Control Circle (QCC), Total Quality Management (TQM), design of experiments, Process Failure Modes and Effects Analysis (PFMEA), and Six Sigma (6 Sigma, 6) method, among others. Six Sigma can effectively enhance the overall capacity of the process with a systemic and comprehensive approach. Based on the ideas of C. Lin (2009) with a systematic DMAIC process and tactic, only Six Sigma can improve product quality comprehensively. It usually starts with key customer needs and internal process needs, then affirms the key quality index and key process index, clarifies the definitions of key input, process, and output indexes, and recognizes the critical factors using a Cause and Effect Diagram and PFMEA.

Six Sigma is a quality-improvement initiative that utilizes a plethora of services in a DMAIC-style process (define, measure, analyse, improve and control). Six Sigma aims to discover and eliminate the root flaws or defects in business processes. Six Sigma focuses on outputs that are critical to customers (L. B. M. Costa et al., 2021). Process yield and process