An opportunity of Maynard Operation Sequence Technique for autonomous productivity in agriculture

Nur Farah Bazilah Wakhi Anuar[1,*], Shurein Arumugam[1], Wan Mohd Bukhari Wan Daud[2], Ahmad Fuad Abdul Rasid[1],

[1]Faculty of Mechanical and Manufacturing Engineering Technology, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia
[2]Faculty of Electric Engineering Technology, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia

[*]Corresponding author's email: nurfarah@utem.edu.my

1. ABSTRACT: Nowadays, threats to global food from various sources such as population growth and ageing farming population are impacts to agriculture as well promoted. To meet the needs for food, certain large-scale agriculture sectors are shifted to smart farming technology using modern technology devices, sensors, and machines. Despite the existence of such programmes, small-scale still contend plagued inefficient manual pesticide activity to avoid insect attack on crops as one of the major concern sources due to limited wide technology system. Hence, this study is proposing the Maynard Operation Sequence Technique be applied to pesticide activity in the agriculture sector with 55 x 43 meters' farm lead to productivity improvement in enhancing the efficiencies of crop yield using autonomous system. This application would be producing better yield ,thus improvising working method and process flow.

Keywords: *Productivity; Autonomous system; Maynard Operation Sequence Technique*

1. INTRODUCTION

Today, the facility and layout design determines its complexity and intricacy, which, in turn, influences labour productivity. Long before the computer age, forward-thinking farmers practised what is now known as precision agriculture. Nowadays, farmers are currently attempting to increase crop yields[1]. As a result, the introduction of technology has gained traction among farmers, and rover technology has become more important[2]. Hence, rover technology is now widely used in agriculture, but most agriculture sectors in Malaysia are preferred conventional method. The use of agricultural technology and management systems ensures increased income, equitable distribution of resources, the sustainability of farmland use, and increasing levels of food and agricultural production[3]. Hence, many worldwide industries have undergone dramatic transformations due to the advancement of technology, especially in rover or autonomous systems. Rover is implemented in various economic sectors, including agriculture with relatively low productivity[4]. Developing this technology system reduces human labour and produces effective results in both small and large-scale manufacturing. However, many factors influence agriculture productivity based on technology. Pesticides are widely used in agriculture today to vastly increase agricultural productivity and significant on the elevation of the crop yield[5]. For this reason, it is necessary to ensure the efficient use of resources to diminish irrelevant work and promoting productivity when using the autonomous rover system in the pesticide process.

Previous studies have reported that the used of conventional pesticides may cause several problems, especially to the human health and the environment due to the direct exposure while handling the pesticide liquid [5]–[7]. Although some research has been carried out on the autonomous system in pesticide, there is a general lack of productivity improvement of the pesticide process in agriculture. Therefore, time study is required to develop a more efficient and precise method of time measurement. Many researchers have studied the measurement time enables an organization's work to be more efficient and straightforward[8]. Maynard Operation Sequence Technique (MOST) is a user-friendly and simple-to-learn methodology that a wide variety of sectors have used as one of the most efficient works measuring systems available[9]. Hence, MOST were created with the goal of standardizing and distributing processing time within an organization. Thus, the main objective of this study is to propose application of Basic MOST technique to be applied to pesticide activity in the agriculture sector for productivity improvement and lead to enhance the efficiencies of crop yield when using autonomous systems.

2. METHODOLOGY

2.1 MAYNARD OPERATION SEQUENCE TECHNIQUE

The research is analyze labour productivity and the improvement approach for the application of autonomous systems in agriculture. Analysis of existing work methods and their time content expose several areas for improvements, such as the work methods based on scientific techniques and the establishment of time standards. Basic MOST is a technique used for productivity improvement that focuses on three types of

object movements: general movement, controlled movement, and tool use [8]. Figure 1 presents the methodology used in this study. In addition, the bottlenecks and MOST analysis will be identified for productivity improvement, and the task is broken down into individual motion elements for 55 x 43 meters' farm. Table 1 provides an expression of the specification used in basic MOST analysis arrangement models. The index value for each notation can be found on the MOST data card.

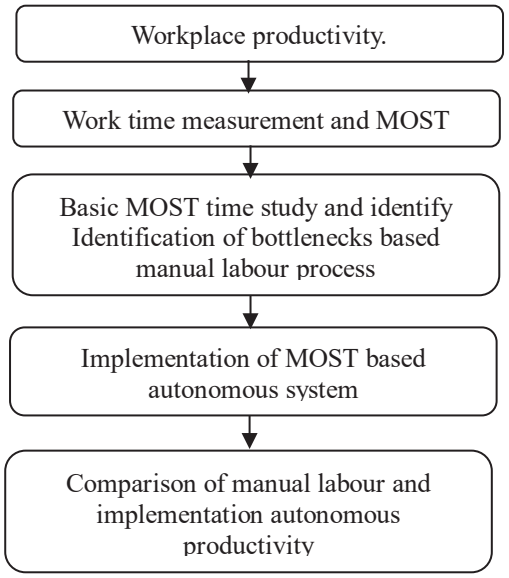

Figure 1 Methodology adopted for workplace productivity analysis

Table 1 Specification used in basic MOST analysis[8][10]

Notations	General Move	Controlled Move	Tool Used
	Clarification		
A	Action Distance	Action Distance	Action Distance
B	Body Motion	Body Motion	Body Motion
G	Gain Control	Gain Control	Gain Control
P	Placement	-	Placement
M	-	Move Control	-
X	-	Process Move	-
I	-	Alignment	-
T	-	-	Tool Action

3. CONCLUSION

The rise of autonomous technology systems in the agricultural sector has attracted the attention of researchers to increase productivity. In this paper, an attempt is made to identify the improvement of productivity based on manual labour and the application of the autonomous system in agriculture. Incorporating the MOST will improve the working methods, balance the process flow, and estimate the standard time, especially for the pesticide process. Moreover, this method will provide the most effective solution to the growing demand for increased productivity.

ACKNOWLEDGEMENT

The authors would like to tthank the financial supportfrom the Universiti Teknikal Malaysia Melaka (UTeM). The short term grant number for the project is PJP/2020/FTKMP/PP/S01746.

REFERENCES

[1] P. Nevavuori, N. Narra, and T. Lipping, "Crop yield prediction with deep convolutional neural networks," *Comput. Electron. Agric.*, vol. 163, p. 104859, 2019.

[2] Z. Wang, J. Yang, P. Liu, X. Long, H. Li, and W. Wei, "Development of an agricultural vehicle levelling system based on rapid active levelling," *Biosyst. Eng.*, vol. 186, pp. 337–348, 2019.

[3] A. E. Ozcelik, "Driving initiatives for future improvements of specialty agricultural crops," *Comput. Electron. Agric.*, vol. 121, pp. 122–134, 2016.

[4] T. Talaviya, D. Shah, N. Patel, H. Yagnik, and M. Shah, "Implementation of artificial intelligence in agriculture for optimisation of irrigation and application of pesticides and herbicides," *Artif. Intell. Agric.*, vol. 4, pp. 58–73, 2020.

[5] V. Kumar, K. Vaid, S. A. Bansal, and K. H. Kim, "Nanomaterial-based immunosensors for ultrasensitive detection of pesticides/herbicides: Current status and perspectives," *Biosens. Bioelectron.*, vol. 165, p. 112382, 2020.

[6] P. Jian-sheng, "An Intelligent Robot System for Spraying Pesticides," *Open Electr. Electron. Eng. J.*, vol. 8, pp. 435–444, 2014.

[7] C. Zhang, S. Guanming, J. Shen, and R. Hu, "Productivity effect and overuse of pesticide in crop production in China," *J. Integr. Agric.*, vol. 14, no. 9, pp. 1903–1910, 2015.

[8] N. A. Medha, S. K. Reddy, K. E. K. Vimal, A. R. Sakthivel, and J. Kandasamy, "Labour productivity improvement using hybrid Maynard operation sequence technique and ergonomic assessment," *Int. J. Enterp. Netw. Manag.*, vol. 11, no. 2, p. 113, 2020.

[9] M. N. Che Ani and I. Abdul Azid, "Investigation on Effective Pre-determined Time Study Analysis in Determining the Production Capacity," *Adv. Struct. Mater.*, vol. 119, pp. 83–91, 2019.

[10] R. Kumar, P. Kalra, and S. Kant, "Productivity enhancement of assembly line by using Maynard operation sequence technique after identification of lean wastages," *Int. J. Product. Qual. Manag.*, vol. 29, no. 4, pp. 463–482, 2020.