Enhancing Mechanisation Technology in Oil Palm Plantation

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ABSTRACT

Oil palm plantations are facing several challenges in overcoming productivity loses during the COVID-19 pandemic. The implementation of mechanisation and automation technology in plantation were identified as possible solution. However, the effort has been ongoing for several years back but the adoption has not been very successful. Introduction of new mechanisation for oil palm plantation has been spearheaded by various research entities and institutions, but they are only able to come up with a prototype at Technology Readiness Level (TRL) 5 based on The National Aeronautics and Space Administration (NASA) standard due to their limited capability in terms of funding and fabrication facility. The objective of this article is to identify the challenges in adopting mechanisation and technology in oil palm plantation as well suggesting a solution to the problem. Agriculture Technology Revolution 4.0 concept which mimicking Industrial Revolution 4.0 (IR4.0) has the potential to address the technology adoption in plantation but only certain elements are deemed suitable to be implemented in plantation. The nature of mechanisation which consists of complicated and intricate process that require an extend of fabrication engineering technology, manpower, experience and high capital have added to the challenges to make the adoption of mechanisation in plantation viable. In order to overcome these challenges, an additional entity, namely a Manufacturing Powerhouse is needed in the equation due to its potential capability to address all the issues identified earlier. Hence, it is important to convince a Manufacturing Powerhouse so that the gap between research and development (R&D) entities and plantation can be narrow down as close as possible.

INTRODUCTION

Modernisation in any aspect of life requires adoption of technology in order to lessen the burden as well as increasing efficiency. In oil palm plantations, farm mechanisation has been a continuous effort contributed by various research agencies and institutions such as universities.

Throughout the years, variety of research products have been innovated to fit various types of plantations, topographies and activities. Some of the machinery developed are shown in *Figure 1*, ranging from complex mechanism such as hydraulic powered Hydraporter, to as simple as motorcycle trailer. Other than that, some of these mechanisations, such as the hydraulic arm grabber and motorised cutter known as CANTAS, have been widely adopted by the industry, although at a modest rate. In spite of this, most of the inventions developed through research and development (R&D) have not been able to receive proper acceptance due to several factors.

One of the identified factors is the level of technology development in oil palm mechanisation and automation. Most of the research and development agencies or institutions are only capable of reaching technology validation stage or specifically at Technology Readiness Level (TRL) 5 only based on the guideline set up by the Ministry of Science and Technology (MOSTI) (*Figure 2*) (MCYPortal, 2021). The TRL which was introduced by MOSTI, has been adopted from The National Aeronautics and Space Administration (NASA) standard to indicate the technology development from the concept idea (TRL 1) to operational deployment level (TRL 9). A lot of resources are required to achieve the operational deployment level or commercialisation stage, which certainly cannot be provided by a single entity only.

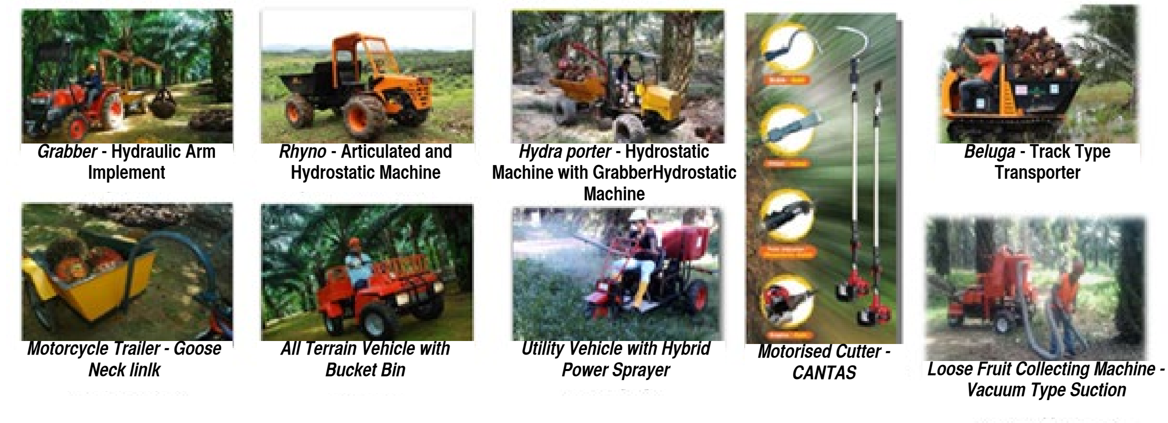


Figure 1. Machinery and mechanisations developed by R&D entities.

Figure 2. Technology Readiness Level (TRL) guideline diagram from MOSTI.

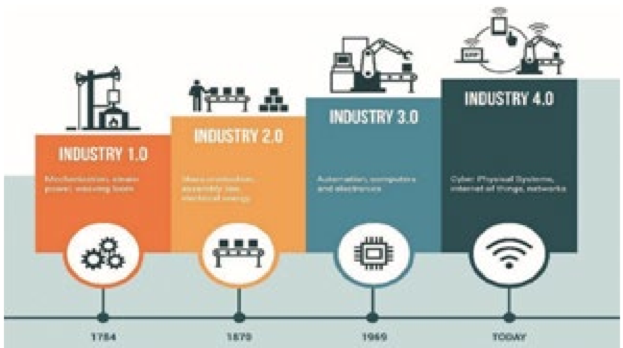
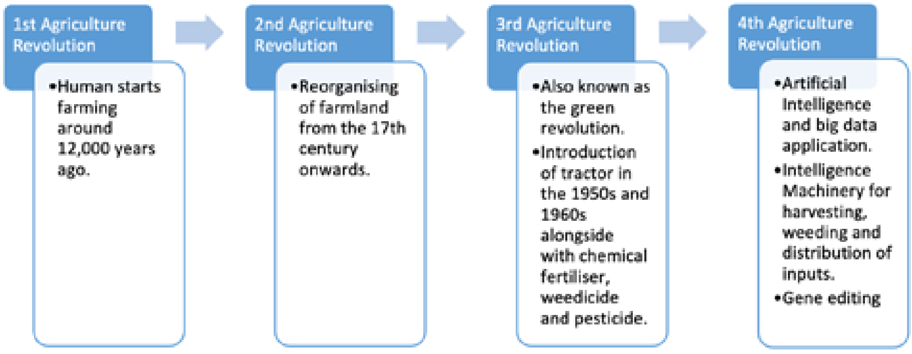


Figure 3. Development stages of Industrial Revolution.

ADOPTION OF MECHANISATION IN OIL PALM INDUSTRY

Adoption of mechanisation and automation is the basic key aspect in revolutionising the oil palm industry. The trend is actually very similar to the European Industrial Revolution during the 1970s where the European began to shift into machinery and mechanisation in order to speed up the output of their industries (Styles, J., 2020). The conventional labour workforce was slowly replaced by more efficient machinery and their technological advancement has never stop developing since then. In general, there had been already four stages of industrial revolutions in the world (Skillton *et al.,* 2018). *Figure 3* summarises the development stages of the Industrial Revolution throughout those centuries (Bessegato, 2019).

Industrial Revolution 4.0 (IR4.0) in general, consists of nine components, which are Augmented Reality, Big Data, Internet of Things (IoT), Simulation, Cyber Security, Cloud Computing, Additive Manufacturing, System Integration, as well as Autonomous System (Tamby and Dardak 2020). In reference to IR4.0, the term Agriculture 4.0 is coined to refer to application of IoT, precision farming, drone technology, Artificial Intelligence and the usage of big data analysis in agriculture. Summary of the Agriculture Revolutions (AR) are depicted in *Figure 4* (David Rose and Charlotte-Anne Chivers, 2020). Trends for embracing for AR4.0 is becoming more crucial due to rampant issue of labours shortage and also the demands to improve the quality of food sources.



Source: David Rose and Charlotte-Anne Chivers, 2020.

Figure 4. Agriculture revolution.

Unfortunately, not every type of crop can adopt AR4.0 without major modification due to complexity in farm management and crop harvesting. As such, certain major crop producers are still keeping conventional manual labour process. The oil palm industry for example, is just about to enter the second Industrial Revolution with the introduction of electric powered harvester known as CANTAS Electro and some drone technology for several applications. The main contributing factor for such slow pace in technology adoption in the industry is due to the high cost in implementing these technologies and heavy reliance on cheap foreign labour, which has never been sustainable from the beginning where almost 80% of the plantation activities are monopolised by foreign workers. They are very much prone to human trafficking, forced labour, social and economic issue etc. which reflect negatively toward the industry itself. This was proven as when the COVID-19 pandemic hits, Malaysia lost up to RM12 billion of revenue due to the scarce foreign labour workforce which was not able to enter our borders as a result of the movement restriction order to curb the spread of the pandemic (The Star, 2021). Therefore, the notion that 'The pandemic does not break a system, it just merely exposes a broken one' remains true and relevant especially for the oil palm industry.

INTRICACY AND COMPLEXITY OF MECHANISATION TECHNOLOGY

The adoption of mechanisation has been almost neglected all this while prior to the pandemic. When the pandemic hits, there is barely no comprehensive backup plan to increase the implementation of mechanisation in the industry. Although many R&D institutions and agencies have come out with various types of machinery and mechanisation technology, they are all mostly at the prototype stage and not ready to be widely adopted by the industry. Majority of the mechanisation technologies developed are usually transferred to third party for commercialisation but they were normally taken up by Small and Medium Enterprises (SME). Since the size of the enterprise is only small and medium, this means that their capital and technical expertise are also small and medium in size, whereas development of mechanisation for the industry requires vast amount of capital and technical support, up to the level where they need to be able to develop and set up their own production line. Government support was also provided to encourage the participation of SMEs such as Malaysian Technology Development Corporation (MTDC) and SME Corp in the manufacturing sector, but it was not sufficient enough since the major issue was that SMEs were not ready to provide resources and infrastructure from the outset, which impedes the provision of good product. Only heavy industry players are able to cater for such requirement.

In reality, developing or producing any mechanisation technology is a very intricate and complicated task, none of which is within the capability of SME to handle with their limited resources. In contrast to other branches of engineering, such as chemistry, a mere change in substance or technique may already resulted in the creation of a whole new product, with a plethora of scientific publications describing the new discoveries. *Figure 5* is an example of the parts required for a simple car to function which consists of thousands of parts (Motorised Image Ltd, 2021).

Figure 5. Parts required for a simple workable car

The parts lined-up shows the complexity of basic mechanisation (*Figure 5*). The purpose of this mechanised car is only to carry human as passenger from one point to another with a petrol-powered engine. Some of the parts such as spring suspension, gearbox, braking system *etc.* were wholly produced by other companies or parties known as vendors to speed up the production as well as reducing the production cost for each of the parts. Now imagine the intricacy and complexity of mechanisation for oil palm which consists of a combination of diesel and hydrostatics powered mechanism to navigate in challenging plantation's land topography. Obviously, this is not a simple task and is certainly beyond the capabilities of a SMEs entity. SME will benefit more if they can adopt basic mechanisation prototype, such as a motorcycle trailer, and concentrate on manufacturing a single component, such as chassis, body kit, or suspension system, rather than manufacturing the whole equipment. This approach does not seek to denigrate SME; rather, it seeks to increase the participation of diverse SME and to provide more possibilities for other SMEs. This production management also prevents foreign party from producing the technology with poor quality and expose it to be copied illegally.

Due to the absence of mass production capacity, other than restricted workforce, the complexity of developing mechanisation is also a significant barrier for most of the research entities. Such limited number of workforce is in fact just sufficient to create a decent chassis and suspension system based on real engineering world. Therefore, common public expectation for these R&D entities to come up with their own user-friendly product is a bit far fetch. The ability of research entities and their success for decades had been in the development of a completely functioning prototype. Machinery such as Hydraporter, harvesting machine, Otowei, Beluga *etc*. are fully workable proof of concept prototypes. However, they are not user friendly and cost effective enough to be used in plantation environment. What they need is just a little bit of further design optimisation so that the user friendliness and cost-effective elements can be achieved. Unfortunately, this measure is too redundant for research entities to handle, especially in terms of financial strength, and therefore it is a supposedly a task for manufacturing company which needs to be taken via certain technology transfer arrangement. Other renowned research agencies such Fraunhofer Institute, German Aerospace Centre *etc.* also do not produce their own product as well. Most of their findings were transferred to other commercial entity to be further developed and commercialized, just as what most of the local R&D entities have been doing. Unfortunately, most of these leading manufacturing companies, chose to wait and see if the technology survives, as experienced by CANTAS technology.

THE WAY FORWARD IN DEVELOPING MECHANISATION

It is crystal clear that R&D entities alone are not sufficient in developing technology capable to reach the user friendly and cost-efficient level for it to be commercialized and accepted by the industry. Therefore, what is really needed to bridge this gap between R&D entities and oil palm industry is a capable manufacturing powerhouse which has enough capital and expertise to successfully set up a production line as well as further optimise the initial prototype developed by the R&D entities. Usually, companies involved with heavy industry are more than capable of handling such tasks.

Numerous manufacturing companies in our country could serve as examples where they could encompass many departments and specialised knowledge in the development of product or machine. Participation of engineers from different engineering fields is highly needed. These companies usually have their own Research and Development (R&D) Division as well and this enabled them to carry out further design development to enhance a prototype's capability, as well as reducing manufacturing cost of the machinery through mass production. Mass production is not an issue for manufacturing powerhouse with their capital and financial capability. With the help of their R&D manpower, optimisation of the prototype design can also be done efficiently so that the performance of the machinery is acceptable with attractive operational cost in the eyes of the oil palm industry players.

Currently there are a few potential manufacturing powerhouses, especially those from government linked companies (GLC), which have the potential to bring the development of oil palm mechanisation technology to advanced pace, especially in order to fulfil the lack of manpower issue. Such development also enables oil palm plantation to increase its efficiency, thus increasing the productivity and export value that directly contributes to the increase in the nation's income. Therefore, it is crucial to convince them to come aboard as well in the effort to further develop mechanisation technology for oil palm industry, so that the chance of success for this endeavour could be increased to its maximum potential.

CONCLUSION

In a nutshell, technology implementation especially in basic mechanisation has yet to be fully developed and implemented in oil palm plantation. However, a lot of effort has been carried out in this respect by various R&D entities. Technologies developed so far have not been able to successfully reach the industry player or the end user due to several factors that need to be resolved. Due to the intricacy and complexity in developing mechanisation technology which requires high capital, expertise, experience and manpower, it is essential to include a third party to bridge the gap between the R&D entities and the plantation industry players so that these issues can be successfully addressed.

The party to bridge this gap is Manufacturing Powerhouse who has all the elements required, namely, financial strength and capital, expertise, experience and manpower. This is because the R&D entities as a research agency is only capable of producing a fully workable proof of concept in the form of prototype. Before it can be used by end user, the prototype needs a bit of further development and optimization to improve its performance and operational cost so that it is can become more attractive to the end user. Only Manufacturing Powerhouse has the capability to handle such tasks whereby they are able to set up a complete production line which not only capable of producing the machine in mass volume, but also lower the production cost following mass volume capability. Therefore, it is crucial to convince at least one of them to come aboard and share their expertise and strength so that the development of technology in oil palm industry can be achieved in a faster pace.

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