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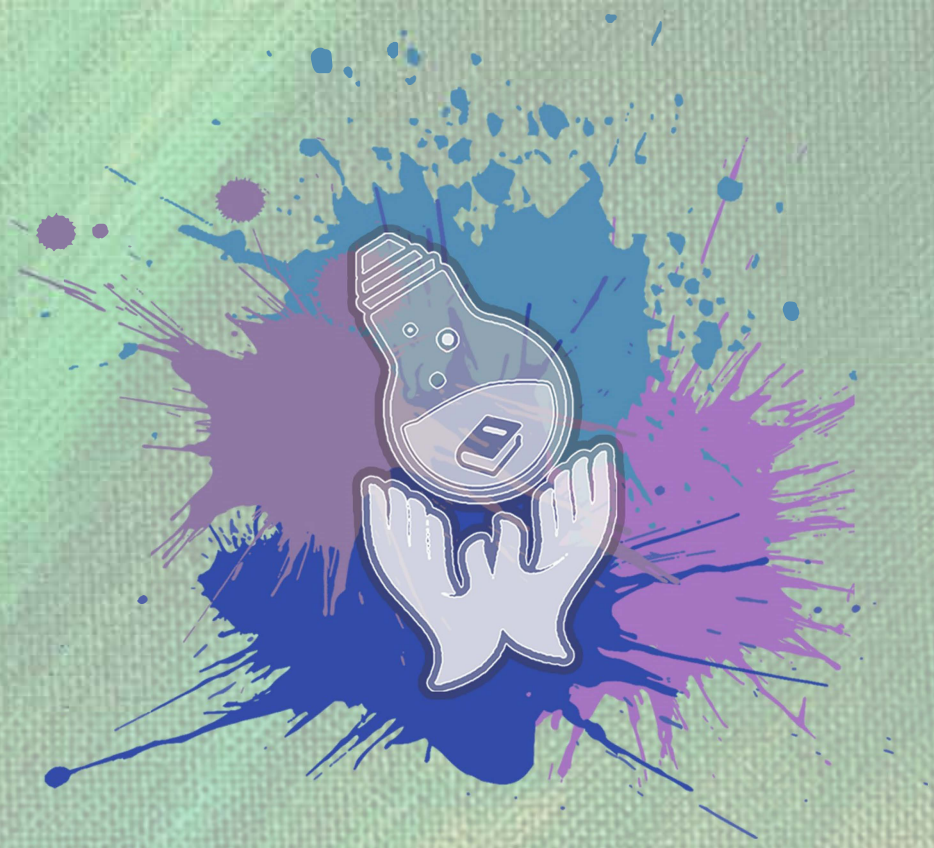

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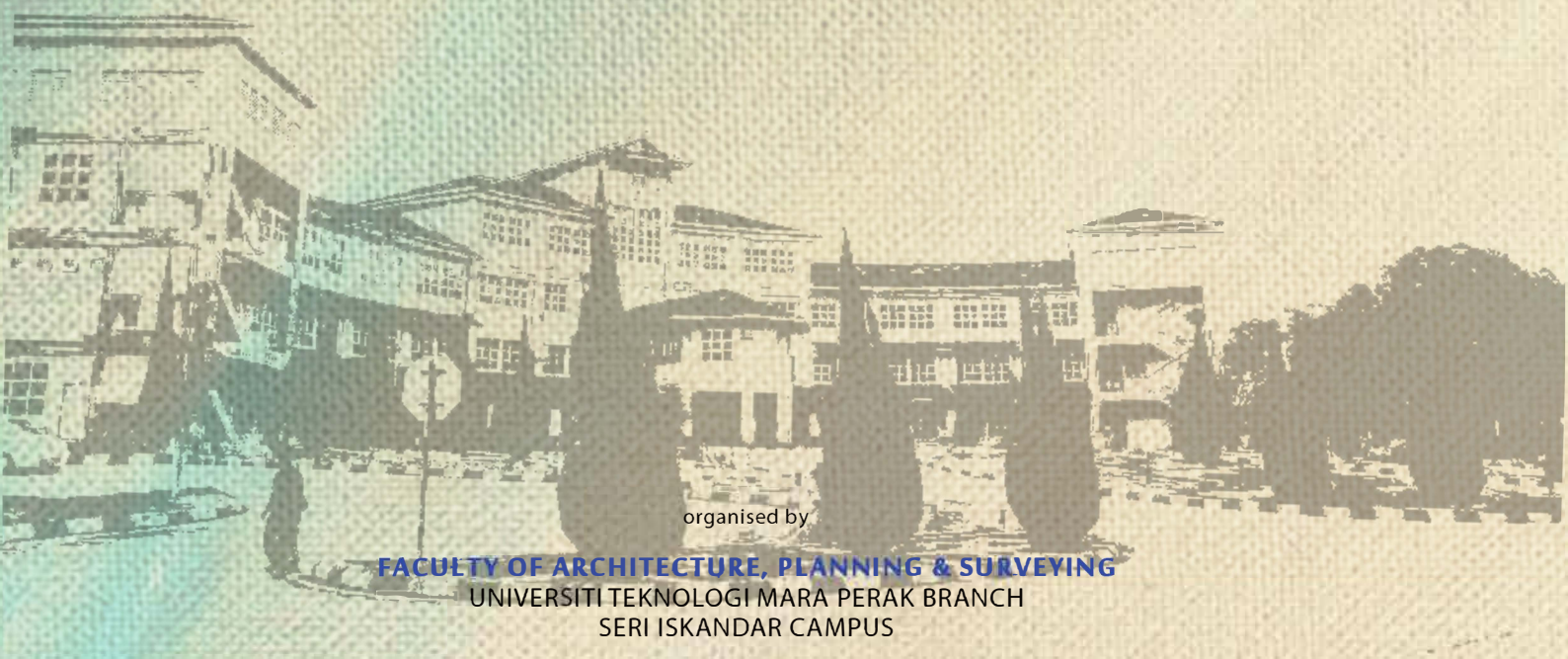

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DEVELOPMENT IDEA OF SMART FORKLIFT

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Abstract:
This study will be focusing on the manufacturing stages, specifically the material handling system of an Industrialised Building System (IBS) component. To run an IBS plant or warehouse, it requires a high number of workers especially skilled worker to handle the movement of the product inside the plant. Other than that, the technologies and machineries used must be safe to ensure the safety and health of the workers. To properly handle an IBS plant, it requires higher technology with accuracy which one of the ways is by replacing the manpower with machineries or robots, since robots works better than human. The main objective of this study is to propose an innovation to cater the problems of material handling of an IBS component in a warehouse or plant. Desk study on relevant research related to the material handling stages and innovation existed will be conducted through a literature review. The data will then be analyses through comparative analysis to come out with the best solution to cater the problems. This study highlights the benefits of having robots in the industry to help human works better and safer as well as following the Industry Revolution 4.0 plan where it is being driven by the conjunction of advanced technologies, such as robotics and artificial intelligence.

Keywords:
Innovation; Industrialised Building System (IBS); Robots

1.0 INTRODUCTION

Innovation is a new way of doing something by creating something new or improving something that is already in the market. One of the innovations that have been made and already proven to have many benefits in the industry is the Industrialised Building System (IBS) construction. An Industrialised Building System (IBS) is a construction system that is built using pre-fabricated components. The assembling of the components is deliberately done by a utilizing machine, formworks and different types of mechanical equipment. Now, Malaysia has come out with the Industry Revolution 4.0 plan where automation and artificial intelligence are the change agents that will replace manpower with machines that will do the job smarter and faster (StudyMalaysia, 2018).

This study focuses on the material handling stages of a blockwork system which is one of the types of IBS System in Malaysia. However, there are several issues and problems related to the stages of material handling of an IBS component. One of it is it requires a high number of workers. This is one of the problems of having an IBS plant since there is a shortage number of skilled worker (Borden T., 2017). Some plants can produce 90 solid blocks per hour or 600 blocks per day (Building Materials & Technology Promotion Council, n.d.) so this will require the use of a large amount of manpower to handle the movement of the product from one place to another inside the plant. Other than that, forklifts are often used in a plant to carry or to store a product and when carrying loads using forklifts, it can become unstable under certain circumstances. With lower stability and uncontrolled balance, it can cause numbers of fatal accident including the workers get stuck or run over by the forklift and in some cases, got struck by falling material (19 Columns, 2017). The material handling stages involves workers manually handling the forklift which sometimes caused an error of locating or storing the component due to the lack of communication and coordination between the forklift drivers

A possible way to cater all the problems arises is by following the plan of Industry Revolution 4.0 which replacing the work of manpower with robot technologies. A robot is a well-known machine that is designed to execute one or more tasks automatically with speed and precision (Margare, 2016) and they

work better than humans which is smarter and more flexible, with the ability to make decisions. The main objectives of this study are to make an improvement of the current technologies used inside the IBS warehouse and to propose an innovation to cater all the problems arises in material handling stages.

2.0 LITERATURE REVIEW

From early years until these days, there are countless innovation that have been implement. With the improvement of technology day by day, all forms of innovation have made significant strides in the industry and it has affected the way human works. This innovation shows that humans are way ahead in designing and creating new technology to help them in finishing their job better and more efficiently.

2.1 Various Innovation Approaches

In early systems of handling materials, goods were handled as single units in a discontinuous manner. Materials handling equipment ranges from the simplest carts and wheel barrows to a specialized variety of highly sophisticated. Overhead runways are one of the earliest approaches in managing material handling in the past where it can lift and move heavy and bulky materials quickly and effortlessly. It has been introduced in 1860s by Middle West (Landon, 1953). During the 19th century, cranes were firstly employed by the Roman and it is use mainly for building and it used where loads have to be picked up, transported and put down anywhere in a fixed area. Other than that, a conveyor system, is a mechanical handling equipment that can moves materials from one location to another (Landon, 1953). Industrial trucks are then introduced which is equipped with a simple small wheel on a scaling ladder (Landon, 1953). The latest technology invented today is an Automated Guided Vehicle. This technology has proved to be appealing to factory and warehouse where it was a simply a tow truck that followed a wire that embedded into the floor of a warehouse or factory (Dan, 2013).

2.1 Evolution of Technology in Construction

The first lifting trucks was introduced in 1887 which made from iron axles and wheels, known as a two-wheel hand truck (McCall Handling Co., 2016) it allowed both horizontal and vertical movement of cargo and lift a platform several inches off the ground. Next, a "Tructractor" which is another forklift or lifting equipment was introduced by a company called CLARK and it was the first internal combustion powered industrial trucks (Clark, 2018). The first hydraulic-powered lifting truck was introduced in 1920 that could lift the forks and their load up via the mast (McCall Handling Co., 2016). Later in 1950, the forklift design has become more powerful, sturdy and it closely resembled modern forklifts. However, most of the forklift invented during the day did not have roof of any kind. So, forklift manufacturers started to notice the problem and solved it by began adding roof to all new trucks in 1960 to avoid the risk of goods falling on a driver. Between the 1960s and the modern day, there have been several advances and changes in forklift technology. One of the biggest achievements of forklift industry were the power sources and the invention of electric forklift (Intella Liftparts, 2015).

3.0 METHODOLOGY

Desk studies are conducted on relevant research related to manufacturing stages of IBS component, innovation and technology approach by referring trusted materials such as books, articles, journals and some information from the internet. From reviewing some of the earlier research by other researches, the data collected are used to identify research problems, and set up research objectives for this study. There are approximately 10 articles that has been reviewed and differentiated according to the topics.

4.0 ANALYSIS AND FINDINGS

Each forklift and Automated Guided Vehicle manufacturer have unique strengths in their models and brands. Based on the literature review done from previous studies and numbers of different companies, the findings of the research are the characteristic of a different forklift model and the guide-path systems for the Automated Guided Vehicle System. From the analysis that has been done, the best specification that fits to the invention of the Smart Forklift is that it is a electric powered system or battery powered that can carries load up to 3500 lbs. and can lift up to 245 inch from the ground where it will be used in managing material handling works inside the warehouse where it will following the tandem guide-path system.

Table 1: Table on the characteristic of a different forklift model

Model Name	Load Capacity	Lift Height Capacity	Uses	Engine Type	Pricing
Toyota	3000 lbs.	240 In.	Storing, Stacking, Moving	Electric	$5000 - $9000
Hyster	3000 lbs.	242 In.	Storing, Stacking, Moving	Internal Combustion	$4000 - $10,000
Doosan	2000 lbs.	245 In.	Storing, Stacking, Moving	Diesel	$20,000 - $25,000
Komatsu	3500 lbs.	244 In.	Storing, Stacking, Moving	Electric	$3,500 - $6,000
Crown	3000 lbs.	245 In.	Storing, Stacking, Moving	Electric	$6,000 - $15,000

Source: http://www.purchasing.com/construction-equipment/forklifts/models-and-price-comparison/

Table 2: Table on findings regarding the research

Features	Conventional	Single-loop	Tandem
Number of vehicles per zone	Multiple	Multiple	Single
Operating with a bidirectional system	Difficult	Difficult	Simple
Traffic control	Difficult	Easy	Easy
Vehicle scheduling	Complex scheduling/dispatching system	Simple	Simple
Probability of congestion	High	Low	No

Source: https://www.sciencedirect.com/science/article/abs/pii/S0377221705001840

5.0 CONCLUSION

The existence of technologies in the industry especially construction industry has proved that it is very crucial. The evolution of technologies in the past until this day showed that the industry needs for stronger, more accurate and more efficient medium in carrying out the works. The invention of Smart Forklift will be the stepping stone to the industry of IBS component production as it will brings many benefits to the IBS players. It also boosts up the economy because companies need to be efficient to keep up with the industry competition. This innovation will also lead to the program and plan of Industry Revolution 4.0 where automation and artificial intelligence are the main drive where it is expected to change how we live, work, and communicate.

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