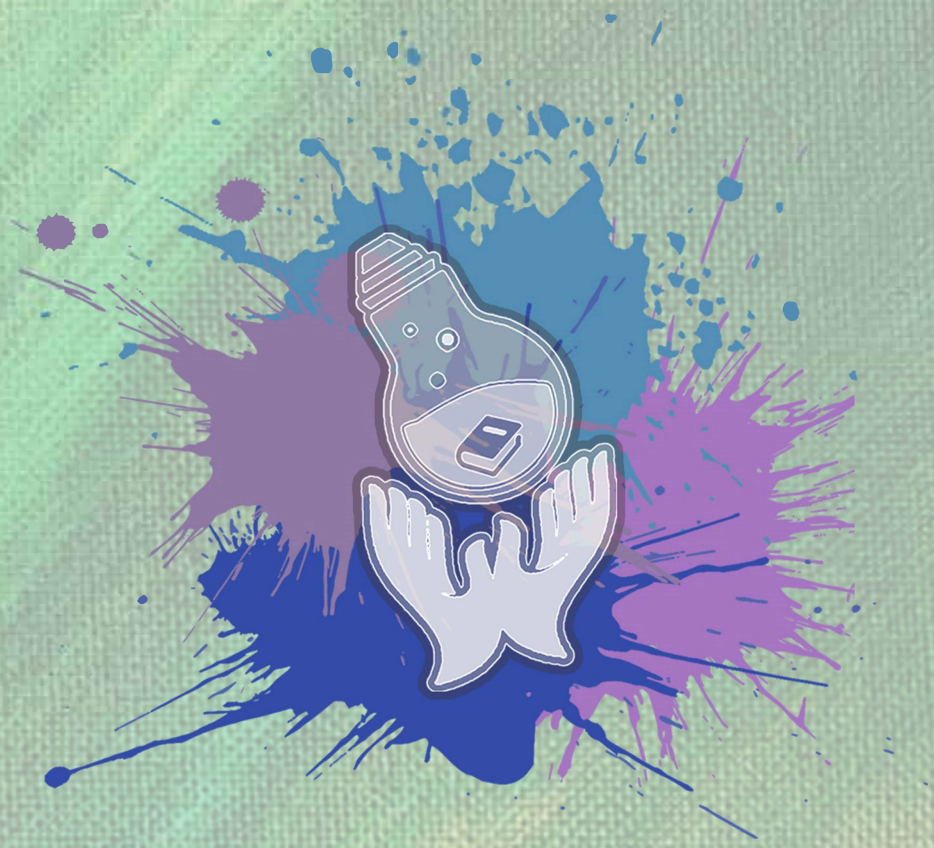
UNIVERSITI TEKNOLOGI MARA

F|S|P|U
FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

2019

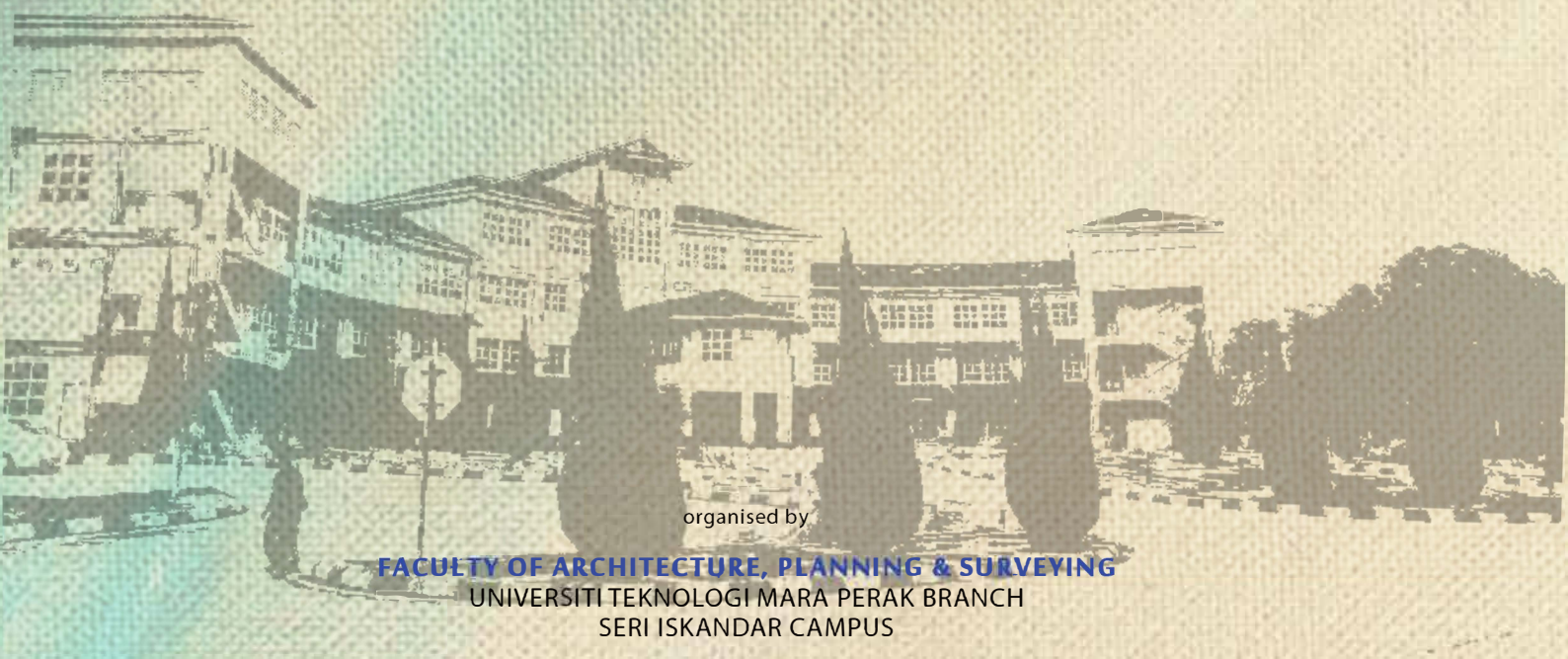


4th UNDERGRADUATE SEMINAR 2019

BUILT ENVIRONMENT & TECHNOLOGY

e-PROCEEDING

eISBN-978-967-5741-97-5



organised by

FACULTY OF ARCHITECTURE, PLANNING & SURVEYING
UNIVERSITI TEKNOLOGI MARA PERAK BRANCH
SERI ISKANDAR CAMPUS

UNMANNED AERIAL SYSTEM (UAS) FOR MONITORING AND COMMUNICATION IN IBS CONSTRUCTION PROJECT

Anis Sofea Binti Mad Said[1] and Wan Akmal Zahri Bin Wan Zaharuddin[2]
[1 2] Department of Building, Faculty of Architecture, Planning and Surveying,
Universiti Teknologi MARA, Perak Branch, Seri Iskandar Campus, 32610 Seri Iskandar, Perak
Email*: sofeas96@gmail.com*[1]

Abstract:
Industrial Revolution 4.0 (IR) is changes in work, workers, management and cycle of work by using technology. Industrialized Building System (IBS) construction management in site can be improve by applying IR 4.0. The problems in managing of IBS project arise from the practice of manually monitoring the Precast Concrete (PC) components arrived at the site which is tedious and susceptible to human error. In addition, the problem of communication by signal person to crane operator in PC components assembling can be misinterpret. The purpose of this research is to identify the problems of IBS management onsite and to propose Unmanned Aerial System (UAS) for Monitoring and Communication (UMAC). The method used in this research are by desk study and simulation to gain the information and performance. The result is gained by simulation and differentiate the performance of UAS in market and the application in construction site. For the conclusion, Application of UMAC in IBS construction give benefits in systematic practice and use of technology in solving problems.

Keywords:
Industrial Revolution (IR) 4.0; Industrial Building System (IBS); Unmanned Aerial System (UAS); Monitoring; Communication.

1.0 INTRODUCTION

Industrial Revolution 4.0 (IR) is the use of technology and digital connectivity. IR 4.0 applied in construction industry will help in improve the construction quality by using technology. Meanwhile, Industrialized Building System (IBS) is off-site manufacturing of building components and assemble the components on-site. Thus, IBS and IR 4.0 connectivity through the technology used in the manufacture and systematic data collection. UAS is a mini aircraft system that flown by pilot off ground by the controller. Hence, the study focuses on the usage of Unmanned Aerial System (UAS) in construction site for monitoring and communication of IBS construction.

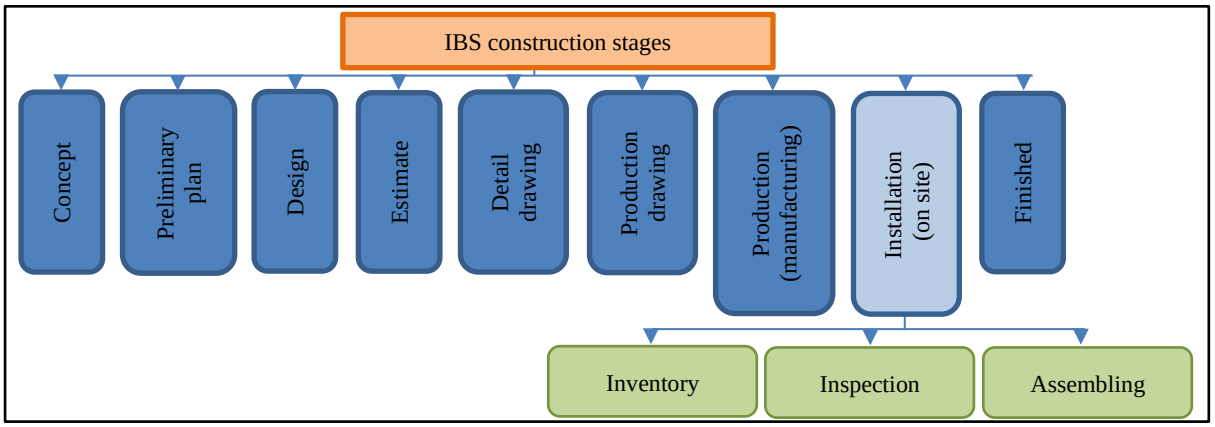


Figure 1: IBS construction stages.

From the figure 1 above highlighted in green focus in IBS installation on-site where the innovation will be implemented in inventory, inspection and assembling task. The current issue promoting the usage of technology in the construction industry. The problems are of manual inventory and inspection on-site

still using manual data collection. While assembling of PC components by lifting crane, the signal person given instruction to crane operator through hand gesture can affect workers safety and human error. Thus, the objectives of the study are to identify the problems in IBS site management and to purpose UMAC in the IBS installation stage.

2.0 LITERATURE REVIEW

The literature review focus on reviewing articles related to IBS on-site management and UAS evolution and features integrated with UAS. The article reviewed are published from 2013 to 2018 to ensure the article are still relevant and the topic is a relatively new concept. In this report, the reading material obtained which include journal article, conference papers and website.

2.1 IBS site management and UAS features

IBS site management consist of inventory Precast Concrete (PC) components upon arriving on-site, PC components surface defect inspection and the assembling of PC components using lifting crane. Currently, the practice for tracking materials still lacking by using manual and excessively paper-based (Narimah et al., 2013). Thus, the improvement of managing the IBS inventory and inspection can be achieved through operational visibility and components traceability (Wang, Hu and Zhou., 2017). As stated by Fang (2018), lifting crane safety can be jeopardized by poor coordination and communication between personnel such as riggers, signal person and ironmakers (Fang et al., 2018). Hence, using technology can provide another layer of safety, protection and awareness in improving lifting crane safety performance. Thus, using UAS as a flying robot aims to solve the problems of monitoring and communication. In addition, UAS widely use in construction industry especially in surveying, aerial photography, inspection and security monitoring (Tatum and Liu, 2017). UAS application is a great platform for automatics data collection (Dupont et al., 2017). Moreover, UAS can be integrated with various features technology that can help in better application in construction industry such as Radio Frequency Identification (RFID), Building Information Modelling (BIM) and others (Narimah et al., 2013).

3.0 METHODOLOGY

The method of this study in figure 1 begins with problem statement on the issues in the construction site, then from the concept idea inspired by smartphone application the methodology conducted by desk study and simulation. The desk study conducted by reviewing articles related to the research. The issues covered in desk study is the IBS on-site management, UAS evolution and features integrated into UAS. Moreover, in simulation conducted by SketchUp software application in two parts. The first part is the simulation on the assembling the UMAC components. The second part is by the performance of UMAC in IBS construction site.

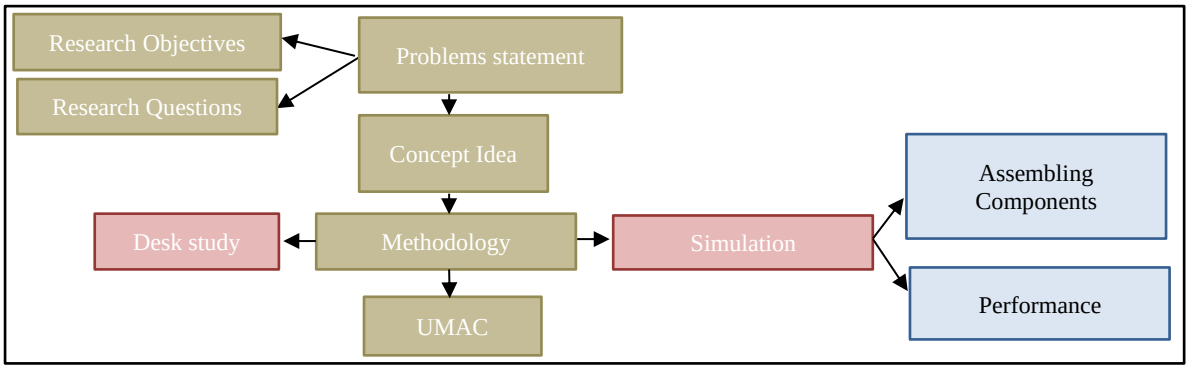


Figure 1: Purposed technology for UMAC.

4.0 ANALYSIS AND FINDINGS

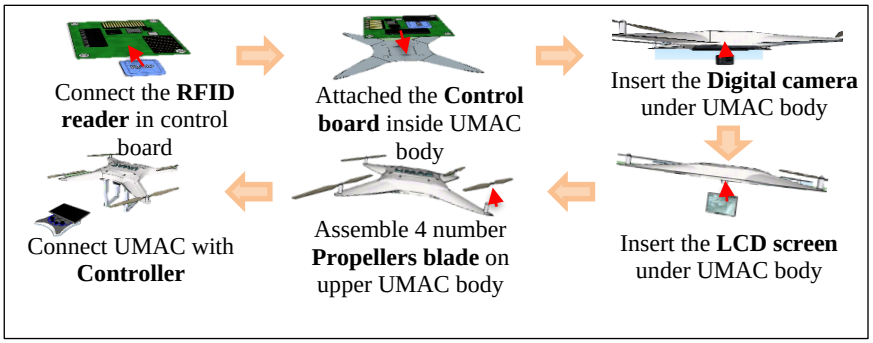


Figure 1 : Assembling components of UMAC.

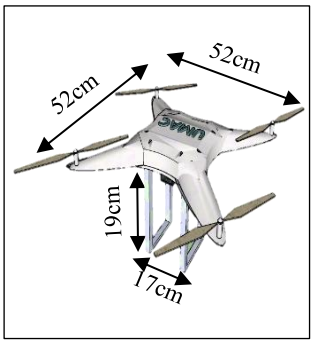


Figure 2 : UMAC size.

The simulation of the assembling sequence in Figure 1 UMAC components consists of six major components. The components are RFID reader, control board, digital camera, Liquid-Crystal Display (LCD) screen, propeller blades and controller with a built-in screen. The size of UMAC is shown in Figure 2 with dimensions 52cm x 52cm x 19cm. The performance of UMAC in IBS construction site for inventory PC components, UMAC flown by pilot upon the PC components arrived on-site and RFID reader inside UMAC read passive RFID tags embedded in PC components. Next for inspection for defect on surface of PC components, Pilot flown UMAC while crane lifts the PC components, then digital camera detects any crack occur on the surface PC components. The crack detected by digital camera extract the pixel indicate crack image. The data list of PC components arrived on-site and defect PC components will be sent to the manufacturer for record. After that, for communication to the crane operator, UMAC will be placed or hanged outside the lifting crane for crane operator watch the sign appear in LCD screen.

From the usage of UMAC described above, it is focusing for the usage in IBS on-site installation. To differentiate the UMAC application and other drone brands application, by referring Table 2 clearly can be seen UMAC performance suitable to be used in IBS installation. The task in assembling PC components on-site requires monitoring for each inventory tracking and inspection activity conduct with careful. This will help inspector to improve inspection of PC components on-site. An additional task of UMAC which communication with crane operator through LCD screen makes the device unique. The function of LCD screen not to eliminate the signal person but to help in better communication with crane operator. The misunderstood and safety on-site can be improved with UMAC.

Table 2: The performance of UMAC and UAS in market.

No.	Brand of UAS	Performance
1.	UMAC	Can perform task of inventory RFID tracking, defect inspection and communication using LCD screen.
2.	DJI Phantom 4	Can perform task site surveying and crack detection (DJI, 2019).
3.	SmartX	Can perform task RFID Tracking and project monitoring (SmartX, 2018).
4.	Parrot	Can perform task for thermal inspection, 3D mapping and site supervision (Parrot, 2019).

5.0 CONCLUSION

In conclusion, to achieve IR 4.0, the usage on technology need to be implement widely in all sector especially in construction sector. From this study, the assembling components simulation allows the right components assembled in right place to understand the movement principal of UMAC. The simulation of performance shows the suitability of UMAC used in IBS construction. This study expected to solve the problems of IBS construction with the use of technology. Thus, UMAC can provide the solution and gives advantage in systematic IBS construction practice. The time taken in conducting the PC inspection can be reduced and the quality of on-site inspection can be improved.

REFERENCES

DJI. (2019, NA NA). *How DJI Drones Facilitate Construction Projects*. Retrieved from DJI Enterprise: https://enterprise.dji.com/mobile/construction

Dupont, Q.F., Chua, D.K., Tashrif, A. and Abbot, E.L. (2017). Potential Applications of UAV along the Construction's Value Chain. *Procedia Engineering, 182,* 165-173. Doi: 10.1016/j.proeng.2017.03.155.

Fang, Y., Cho, Y., Durso, F., and Seo, J. (2018). Assessment of operator's situation awareness for smart operation of mobile cranes. *Automation in Construction,85,* 65-75. Doi: 10.1016/j.autcon.2017.10.007.

Narimah, K., Aryabu, A.L. and Mohamad, S.F. (2013). RFID Technology for Materials Management in Construction Projects – A Review. *International Journal of Construction Engineering and Management*, 7-12

Parrot. (2019, NA NA). *Construction innovative turn key solutions for construction professionals*. Retrieved from Parrot.com: https:// parrot.com/business-solution-us/construction

SmartX. (2018, NA NA). *Drone used in construction*. Retrieved from smartxtechnology.com: https://smartxtechnology.com/drone-used-in-construction/

Tatum, M., and Liu, J.(2017). Unmanned Aircraft System Applications In Construction. *Procedia Engineering, 196,* 167-175. Doi: 10.1016/j.proeng.2017.07.187.

Wang, Z., Hu, H., and Zhou,W. (2017). RFID Enabled Knowledge-Based Precast Construction Supply Chain. *Journal of Computer-aided civil and infrastructure engineering, 32(6),* 499-514. doi: 10.1111/mice.12254.