Chapter 25
Real-Time Construction Waste Reduction Using Unmanned Aerial Vehicle

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ABSTRACT

The paradigm shift towards waste reduction in the construction industry has produced revolutionary techniques in assessing and mitigating waste during the construction lifecycle. Unmanned Aerial Vehicle (UAV) technology presents potentials in real-time construction waste management for informed decision-making processes for site managers. Due to the dynamic and complex construction work environment, material and equipment, labour and management policies are subjected to latent and identified hazards. Therefore, this chapter focuses on the real time impact of construction waste. UAV technology was adopted. UAV flight mission and deployment time were designed to meet target requirements and snapshot checklist. Data images were captured from an 11-storey residential building and analysed for conformity to construction waste and safety requirements. The prevalence of exposed material and equipment, low labour awareness, and need for policy shift to circular economy was predominant. Further studies can explore multiple construction monitoring and other category of construction works.

DOI: 10.4018/978-1-7998-0369-0.ch025

INTRODUCTION

The tremendous growth on examining the impact of construction activities on the environment has spun sensitisation among all construction stakeholders. Extensive tools have been developed addressing construction waste management and characteristics. This can be broken down into waste management plans and guides, waste data collection tools, waste estimation tools and environmental assessment tools (Akinade et al., 2018). Emerging research areas in waste management focus on decision making in planning and design phase, lifecycle evaluation, circular economy approach, human factor related issues and induction of new technology (BIM, GIS, Big Data and prefabrication) for construction (Jin, Yuan, & Chen, 2019). Knowledge gaps exists in stakeholder participation and collaborative governance for waste management. Similarly, individual versus organisational behaviour is inherit in the constructions. Lack of attention to social sustainability assessment and infusing of new technology and methods (Chen, Su, Si, & Chen, 2018). Similarly, more application of BIM and UAV for site management is lacking in literature (Alizadehsalehi, Yitmen, Celik, & Arditi, 2018). Contractor employee knowledge was found to be lacking and a major predictor of construction waste reduction (Li, Zuo, Cai, & Zillante, 2018). Poor site management practices currently plagues effective construction waste minimisation (Ajayi et al., 2017). Currently, poor logistics management and site monitoring reduces productivity, increases site safety risk and waste generation (Whitlock, Abanda, Manjia, Pettang, & Nkeng, 2018).

In the design phase, seminal authors attribute drastic changes in conceptual design to accommodate waste management principles (Ajayi & Oyedele, 2018; Akinade et al., 2018; Ghisellini, Ripa, & Ulgiati, 2018; Guerra, Bakchan, Leite, & Faust, 2019; Lu, Webster, Chen, Zhang, & Chen, 2017). While, during execution phase, others (Akanbi et al., 2018; Chulkov & Fachratov, 2018; Maniam, Nagapan, Abdullah, Subramaniam, & Sohu, 2018; Subramaniam et al., 2018; Won & Cheng, 2017) have supported more site observation, simulation and quantification measurement approach. The monitoring and identification of waste and safety risks is an extremely difficult work, especially in a complicated construction site environment (Park, Kim, & Cho, 2016). Quality controls on site are time consuming and inefficient due to limitations of knowledge on work task without real-time information. This increases the level of difficulty for managers to identify and manage defects (Wang et al., 2015). Extensive use of visualization technology in construction cover small areas due to poor penetration performance requiring improvements in training, job hazard area, monitoring and warnings (Guo, Yu, & Skitmore, 2017). Manual observations have become time consuming subject to human errors and inability to cover extensive site layout (Yu, Guo, Ding, Li, & Skitmore, 2017a). Therefore, given the need to constantly monitor waste management practices during the execution phase, this chapter examines the effect of unmanned aerial vehicle (UAV) on real time waste management monitoring. This was achieved through a literature review on current dimension to waste management and UAV deployment in construction industry. Furthermore, real time monitoring was used to gather data towards immediate use by site managers and safety officers. The subsequent sections will give an expanded literature review, methodology and results.

CONSTRUCTION WASTE

Waste is described as the careless use, extravagant or purposeless use of construction resources (Oxford Dictionaries, 2019). An estimated 30% of total weight of building materials supplied to construction sites contribute to construction waste. To reduce such construction waste generation the industry need