CHAPTER

4

4D BIM IN CONSTRUCTION SAFETY MANAGEMENT

Nafisah Abdul Rahiman, Kerk Yee Wen, Kherun Nita Ali, and Shamsulhadi Bandi

4.1 INTRODUCTION

The construction industry has been identified as one of the most hazardous industries in many parts of the world, as measured by work-related mortality, workers' compensation, injury, and fatality rates (Chong & Low, 2014). Accident cases occurrences are quite common in the construction sector. For instance, three workers were found dead after a 300-tonne concrete span collapsed at an MRT construction site in Kota Damansara, Selangor a few years back (Dina Murad & Nadirah Rodzi, 2014). Fatalities of workers in the construction projects expose the safety gap in projects although all workers are required to follow safety rules at construction sites. Most of the accidents occur due to lack of safety and health regulations and poor execution of risk management.

In order to reduce accidents such as work-related deaths and injuries as well as to increase the safety level of projects, Riaz et al. (2014), Alomari et al., (2017), and several others suggested the use of technology and platforms such as building information modelling (BIM) for safety management in construction projects. According to Kiviniemi et al. (2011), site safety planning and management procedures are getting a

special attention; and BIM technologies could present a new way to solve still existing site safety issues. BIM technologies, specifically the four-dimensional (4D) BIM have been found to be beneficial to the construction industry and act as a means to facilitate communication regarding safety aspects. This chapter highlights the potential of 4D BIM in safety management and the barriers to the adoption of BIM for safety management in construction industry in Malaysia.

4.2 BUILDING INFORMATION MODELLING IN SAFETY MANAGEMENT

Safety management can be defined as the process to realise certain safety functions with the aim of protecting human beings, the environment, equipment, and property from unacceptable risk. Building information modelling (BIM) technology can be adopted in many areas in a project lifecycle. In the past few years, stakeholders in the architecture, engineering, and construction (AEC) industry have been gaining enhanced knowledge on BIM and adopted BIM in many areas, including construction safety management.

The growing adoption of BIM is changing how safety aspects are being approached in the construction industry. For example, early detection of the collision issues between existing underground utilities and new buildings during the project planning stage can be conducted through BIM technology and laser scanning techniques. The implementation of BIM is expected to overcome safety problems due to the difficult, hazardous, and dangerous site conditions; prevent accidents on site; and mitigate other safety related issues.

4.2.1 The Potential Utilisation of Building Information Modelling Software in Safety Management

Safety management can be improved by adopting BIM technologies and software to connect the safety issues more closely with construction planning, provide safety communication in various conditions, conduct

safety arrangements, and provide efficient methods for the management and visualisation of up-to-date plans and site conditions (Azhar, 2017). 4D BIM tools and software are used to simulate the construction operations through BIM models. A complete BIM model is defined as a data-rich, object-oriented, intelligent and parametric digital representation of the facility including on safety aspects (Khoshnava et al., 2012). The user can view, extract, and analyse data in the BIM model appropriately to meet various user's needs as well as to generate information that can be used to make decisions and improve the process of delivering the projects.

Various BIM-based tools and software have been well developed and used by professionals in the AEC industry. BIM-based software used as 4D BIM tools are such as Tekla® Structures, SketchUp, Graphisoft® ArchiCAD®, Autodesk® Navisworks®, Solibri Model Checker™, Bentley® and Fuzor Construction®. The potential utilisation of 4D BIM software and technologies in the safety aspect can be divided into several categories based on the existing studies. The categories are the potential in design for safety, potential in inspection and monitoring, potential in safety planning, potential in safety training, and potential in safety communication (Chi et al., 2012). A brief overview of the categories is presented in the following subsections.

4.2.1.1 Potential in Design for Safety

Designing for construction safety is very important to eliminate and avoid hazard on site (Gambatese et al., 2005). The worksite safety can be improved through safer design and well-prepared work method statement (Chi et al., 2012). Ku and Mills (2010) evaluated the potential of BIM as a design for safety (DfS) tool in construction projects. According to Ku and Mills (2010), BIM-related technologies such as DfS tool have the potential to improve safety management and eliminate design errors during the design stage of a project (Xiaer et al., 2016). Recently, there are many studies that focus on design decisions and omissions in which these studies revealed that the design impacts might