Chapter 31
Artificial Intelligence as Virtual Inspector for Construction Waste Dumping:
Case Study of ViAct

Gary Ng
viAct, Hong Kong

Hugo Cheuk
viAct, Hong Kong

Surendra Singh
viAct, Hong Kong

Baby Sharma
viAct, Hong Kong

ABSTRACT

Construction is an activity that fulfills one of the basic needs of humans (i.e., shelter). However, this industry is also known for its excessive waste generation, which impacts the environment if not disposed of appropriately. Much of the waste consists of harmful material; when dumped in the landfills, this leads to gradual leaching of various undesirable ions into the groundwater, causing water quality deterioration. Such leachate-rich water when used by humans for various purposes causes diseases and deformities. Thus, to improve the ecological civilization and to promote the overall ESG proposition in the construction industry, artificial intelligence (AI) is a suitable solution. This chapter puts forward a case study of an AI-based ConTech startup, called viAct that developed and tested AI modules for monitoring waste generation and disposal at construction sites. The AI modules are trained and tested for their efficacy in various construction sites for illegal dumping detection and classification of different types of waste material before they are discharged in landfill areas.

DOI: 10.4018/978-1-7998-7356-3.ch031

INTRODUCTION

The construction industry, from the very beginning, has been non-eco-friendly (Yu et al., 2013; Yuan et al., 2012). Constructions result in development and deterioration of land, depletion of resources, generation of wastes and several other forms of pollution (Ofori et al., 2000; Tam et al., 2006). Various construction activities like demolition, renovation of buildings and new construction, generate various waste materials, such as rubbles and others. Waste generation may take place both during the extraction and the processing of the raw materials as well as the consumption of the final product thereafter (Nowak et al., 2009). The construction culture has always contributed to generating wastes, yet the trade contractors have been from time to time rewarded for their speed, keeping aside the impact, that their work has caused on the environment (Sullivan et al., 2010). Further, the construction industry consumes huge amounts of material and energy and at the same time generates a large number of solid wastes (Yuan et al., 2012). Statistics show that globally the construction industry consumes 25% of virgin wood and 40% of raw stone, gravel, and sand every year (Kulatunga et al., 2006). 40% of the extracted materials are consumed in the production of building materials and construction itself (Kibert & Ries, 2009). Apart from this, 35% of industrial waste in the world is generated by the construction industry (Hendriks & Pietersen, 2000; Solis-Guzman et al., 2009). In the European Union itself, the construction industry generates wastes that amount 2-5 times of the household wastes (Nowak et al., 2009). According to the Rethinking Construction Report by Sir Egan, in the average construction industry, up to 30% of all the construction work is reworked, laborers are utilized to half of their potential, and a minimum of 10% of the building materials from every construction project is wasted (Egan, 1998). The wastes generated by the construction industry have severe environmental, economic as well as social impacts. The environmental impacts include contamination of soil and water, and deterioration of the landscape due to uncontrolled landfills (Leiva et al., 2005). Further, the waste of materials brings about economic costs to the construction industry, since new purchases are to be made to replace the waste materials, and at the same time, the cost of rework, delays, and disposal bring about financial losses to the contractor (Ekanayake & Ofori, 2000). Similarly, the social impact of construction waste includes the health and the safety of the workers, and the image of the construction industry in the society (Yuan et al., 2012). Reduction of construction wastes gains top priority among the waste management options, such as reduction, recycling, and disposal (Yu et al., 2013). The earlier studies conducted in the field of reduction of construction wastes emphasized the direct observation of waste generation (Formoso et al., 2002), the attitude of the operators towards waste reduction (Teo & Loosemore, 2001), and shorting and weighing of waste materials (Bossink & Brouwers, 1996). Recycling has a very important role to play in preserving the areas for urban development in future, and at the same time, improving the quality of the local environment (Kartam et al., 2004). Apart from recycling, inert end-of-life materials can be used for certain purposes such as filling materials for land reclamation (Poon et al., 2001). The construction wastes have a very high recovery potential. 80% of the total construction waste can be recycled (Bossink & Brouwers, 1996). Various countries such as Belgium, Denmark, and the Netherlands have been successful in achieving the aforementioned recycling rate, especially given the scarcity of raw materials and disposal sites (Erlandsson & Levin, 2005; Lauritzen, 1998). In the year 2006-07, Australia disposed of around 7 million tons of construction and demolition waste at the landfills, 42% of which included construction wastes (EPHC, 2013). Similarly in 2005, the UK generated a total of 89.6 million tons of construction and demolition wastes, out of which 28 million tons were sent to the landfills (DEFRA, 2013). The Asian countries have not been an exception to this trend. In Asian countries, such as Singapore, Hong