POTENTIAL EFFECTS OF TECHNOLOGICAL INNOVATIONS ON FACILITIES MANAGEMENT PRACTICE

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Abstract: Advancement in technology innovations, which is necessitated by globalisation has transformed the practice of facilities management (FM). Consequently, cutting edge technologies, including the drone technology, robots, sensors, cloud-based technology and the internet of things have become common tools that facilities managers adopt to achieve value addition in organisations. The adoption of these technological innovations affects both the core business and the employees of the organisations. However, previous studies in this regard have tended to focus more on analysing technological innovations and the core business to the exclusion of the employees. This study seeks to explore the potential influence of technological innovation on the employees because technology in an organisation without the active creativeness of the employee will be incapacitated in service delivery. The study was explorative in nature using the literature as the starting point for evaluating the potential effects that technological innovations could have on the employees of organisations and the challenges faced in their respective implementation in organisations. To this end it is recommended based on the literature search that facilities managers should consider the potential impact of adopting technological innovations on the employees of the organisation.

Keywords: Employees, Facilities Management, Technological Innovations, Technology

1. INTRODUCTION

This paper explores how drones, robots, sensors, cloud-based technologies, and the internet of things have transformed the operations of organisations and the practice of FM. In addition, it will explore the implications that technological innovation has on the employees and therefore the social sustainability of the organisation. These technological innovations are the most commonly adopted in the built environment and the sophistication brought to the business by these technological innovations cannot be ignored by an organisation that seeks to remain competitive in the global economy. With the expanded scope of FM practice, from the micro level of the building unit where it is involved with the designing, construction and maintenance of buildings to the different support services like landscaping, fleet management, human resource management, and food services etc., the facilities manager cannot operate without the adoption of technological innovation as enabling work tools. Although there are studies on technological innovation in FM practice, they are mostly industry based, and motivated by profit maximisation and the need to meet shareholders demand, a posture which is at variance with the current state of FM development with increased interest in understanding the impact that FM makes on the community. Therefore, there is a paucity of scholarly study that evaluates the current trend of technological innovation in FM practice as it affects intricate factors like the employees and social sustainability.

One key success factor of any organisation is the state of the employees (Ngo and O' Cass, 2013). This is apparent because the success of organisation is driven by the creative minds of the employees (Prahalad and Ramaswamy, 2003). Although the adoption of technological innovations can stimulate success in an organisation, it is limited without the active

participation and creativeness of the employee (Bugshan, 2014; Lee, Olson and Trimi, 2012; Zhang *et al.,* 2015). This implies that without people, technology is incapacitated (Fairbank and Williams, 2001; Im and Workman, 2004; Lazarevic, 2012; Zhang *et al.,* 2015). However, previous studies on the adoption of technological innovations in organisations have been passive on the effect of the technology on the employees of the organisations. Ware *et al.* (2017) emphasised the need for facilities managers to understand how technological innovations will affect workforce productivity, innovation, and employment relationships on a sustainable basis. Hence, this study reviews emerging technological innovations in FM practice (drone, robots, sensors, cloud-based technology, the internet of things and social media), and how their influence on service delivery can be upheld by examining the employees and social sustainability in the organisation. The strategy of the study was first to examine the influence of the technological innovations on FM practices, then their implications on the employees and social sustainability.

2. EMERGING TECHNOLOGIES IN FM

2.1 Drone technology

They are also known as unmanned aerial vehicles (UAV). The benefits of using the UAVs include quick access, low cost, and the ability to document asset conditions in an automated fashion (Bobby, 2017). These benefits have attracted the attention of professional facilities managers to the use of drone technology in their maintenance and security operations. As the drone technology capabilities continue to advance in applicability, facilities managers are beginning to realise the benefits of using the drone to perform fundamental maintenance and security activities (Hounsell, 2016; Bobby, 2017). In FM, drone technology can be used to access problematic areas which technicians cannot safely reach or for which the cost of accessing such difficult locations by platforms and scaffolding will be expensive, in addition to the man-hour required to set up and take down scaffolding and the potential danger such areas posed to workers (Hounsell, 2016).

Drone technology allows field technicians to monitor equipment performance and obtain valuable details about critical assets at almost no risk (Bobby, 2017). With the aid of remote-controlled cameras mounted on the drone, it can transmit images of building structures, machinery on a rooftop, and general condition of roofs. Bobby (2017) further argued that drone technology can also provide infrared and X-ray images which can be used to identify structural issues or dangerous leaks in an environment which is potentially unsafe for humans to reach. In addition, to the exterior capabilities of drone, it can also be flown indoors subject to no regulations like the outdoor operations. Drone technology has several potential benefits for facilities managers as they assist in maximising the facilities lifecycle. However, Andrew Dennison, the chief operating officer with Lift Technologies, an unmanned Aerial Vehicle (UAV) services company in Chicago in 2016 expressed that the benefits of drone technology have not been outlined to facilities managers. In his words:

> *"I don't think a lot of them understand what they can get, and the drone operators really don't understand what facility managers want. In six months to a year, as more of these conversations happen, they'll start to get a better feel, and some new software services might help facility managers even more."*

The above statement indicates a significant gap in the knowledge of the facilities managers and the developers of drone technology. This call for an urgent need for collaboration between the facilities managers and the drone manufacturers with a view to manufacturing drones that help to leverage added-value in FM. There is a scarcity of academic literature in FM that addresses the use of drones, whereas there is a substantial amount of industry-based research centred on the use of drone technology in FM. There is a need for research that bridges the gap between practice and the academia concerning the advancement of these technological innovations in FM practice. Some of the questions that are begging for answers includes: what are the common and beneficial facilities applications for drone technology? What regulations governs the use of drones in FM? What specific criteria should be adopted for drone service providers to address FM specific needs? And how can the data from drone services be managed in a way that translates into tangible benefits for organisations? (Petermann, 2016).

Furthermore, other challenges confronting the use of drone technology for FM operations include the high costs associated with the flying a drone and the need for collaboration with the aviation industry (Dennison, 2016). For instance, Dennison (2016) argues that the records of the flight path of the drone need to be available and defined before any flying operation. Some challenges which are of a technical nature, like weather conditions and the strength and clarity of the GPS signals are all considerations that would confront their effective integration into FM practice globally. Dennison (2016) further argues that specifically, the weather condition is critical for a successful flight operation because certain level of rain intensity and wind velocity affects the effectiveness of drone flights. There is also the issue of interference with compass readings and signals when flying close to large metal objects. These are some of the challenges that the facilities managers should be at the forefront of proffering solutions to in organisations.

2.2 Robots

Robots are adopted for a variety of workplace applications in FM. For instance, robots are adopted for portering, maintenance and customer care services (Tanya and Anandan, 2015). In the health care sector, where robots are deployed as porters, there is a marked reduction in crowdedness in hospital corridors by nurses and relatives of patients (Outsourced Client Solutions, 2016). Also, improved efficiency and productivity of nurses who are no longer engaged in the portering services have been noticed. Furthermore, robots in the hospitals have greatly reduced the risk of spreading infectious diseases, and promoted patient's privacy and dignity. In maintenance operations, facilities managers have increased automation of services like cleaning, floor scrubbing, vacuum operations, and grass cutting. Due to the level of noise associated with vacuuming and scrubbing or mopping, they are preferably done at night outside normal office hours, so as not to disrupt conversations and meetings that are conducted in the normal working hours. This traditionally required that lights and heat or air-conditioning be turned on, and a cleaning staff engaged to work at night (Goossens, 2016). However, with the adoption of robots, cleaning services and energy efficiency are enhanced as automated cleaning does not require lighting or heating. Moreover, robots are more effective, and present less risk, compared to their human counterparts especially when cleaning windows in high-rise buildings and when there is challenge of access in small spaces (Goossens, 2016).

Robots are increasingly being deployed for waste management in light of the increasing tonnage of waste generation. The UK government's statistics indicated that 24% or approximately 48 million tons of the UK's total waste in 2012 was from commercial and

industrial activities. This represents a significant volume of waste to be processed by human beings. However, with the deployment of robotic waste sorting systems, which operate using a combination of machine learning technology and range of sensors, an uninterrupted 24 hors waste management operations is possible. The robots sorted wastes at higher rate of efficiency and were more cost effective than human operated waste handlers. Robots are also engaged by facilities managers in the provision of security and safety services. This has reduced cost and improved operational efficiency, especially for facilities mangers who are responsible for management of large portfolios. Robots are usually deployed to help carry out scheduled environmental sampling protocols, conduct regular safety checks, inspect and report hazard risks, and respond to an emergency.

2.3 Sensors

Sensors are increasingly used to detect or measure physical properties and records, or otherwise respond to circumstances where necessary. In the built environment, sensors are basically differentiated into two, namely: infrastructure sensors; and occupant-related sensors. The former is basically used for monitoring powerlines and equipment, while the latter is installed in building facilities to monitor the climate, lighting, safety, security, etc. (Roth, 2017). From an FM point of view the latter type of sensors have a significant impact on practice. When smart sensors are installed in building facilities, the operating costs are reduced, productivity is enhanced, and the occupants' comfort is improved (Roth, 2017). According to Michael Isenberg, a senior associate of building mechanical systems, quoted in Millán (2014), smart sensors like wireless occupancy sensors, daylight sensors, audio/visual sensors, temperature sensors, carbon dioxide sensors, and door access controls are adopted for adequate space management and utilisation, effective energy savings, security and safety management. With the widening scope of FM into human resource management, the use of sensors becomes vital. For instance, in an organisation, a smart sensor can be used to collect detailed information about occupants' presence, location, count, and activities, the data collected can be used to plan the optimisation of FM with respect to hot desking, meeting room bookings, space planning, and energy savings (Yerby, 2013; Roth, 2017). The growing adoption of wireless solutions like sensors is attributed to the increased collaboration and merging of the traditional silos between FM, IT and engineering, despite the majority of the data from sensors are currently not fully optimised for added-value (Millán, 2014). This is attributed to the fact that the data from sensors are currently only being used to detect and control anomalies (Millán, 2014). Hence, there is a need for full optimisation by way of predicting outcomes based on the information from the various data sources to achieve greater value addition in the organisation. Greater value can be derived from data generated from technological innovations if they are presented in a useful and actionable format that the facilities managers can use for predictive maintenance schedule.

2.4 Cloud-based technology

Cloud-based technology has been described by researchers and industry experts differently. For instance, Lau *et al.* (2013, p.2) define the cloud "as a distributed system that can unify resources scattered across various locations and make one or more available to a user on demand". Buyya *et al.* (2008, p.6) define cloud computing as "on-demand provisioning of software, hardware and data as a service". This involves the relying on global applications rather than enterprise application and significant knowledge sharing rather than in-house

expertise. In the context of FM, cloud computing presents an opportunity for unification of the management of facilities in multiple geographically dispersed locations (Lau *et al.*, 2013). This will minimise the prohibitive cost of managing the computer infrastructure in many locations, provide unlimited access to specialised software and the latest updates, and since the cloud is composed of multiple servers and data storage units, failure of a piece of hardware does not prevent the use of the software and data (Lau *et al.*, 2013). For instance, before the advent of cloud technology, FM organisations that have their portfolios scattered in different locations struggled with keeping their running costs low, but cloud technology supports organisations to centrally monitor, control and manage all their portfolios from a single location at an affordable cost.

Some of the capabilities that have been enhanced in FM practice due to use of the cloud-based technology are: the constant improvement to facilities performance because of constant monitoring of building operations with respect to energy use and costs comparison across portfolios for possible area of improvement. Cloud based technology has also facilitated an ability to be proactive in maintenance strategies as problems are identified and resolved promptly. In addition, cloud based technology has enhanced the facilities manager's ability to ensure better occupants' comfort because the conditions of facilities can be continuously monitored on a real-time basis. It has also enabled the availability of real-time alerts about unexpected malfunctions or out-of-specification conditions within buildings and thereby facilitated a prompt response and turnaround time. Hence, the cloud technology has enabled an overall improvement in service delivery on the part of the facilities manager.

2.5 The internet of things

The internet has revolutionised the practice of FM. The internet enables the use of email, instant messaging, laptops, and mobile phones, which are among the technologies that organisations adopt for flexible work schedules (Hoeven *et al.,* 2016). From the FM point of view, facilities managers can carry out their functions from any remote location without necessarily visiting the site through video conferencing, multimedia instant messaging, recording and photographing, using the smartphones and social media technologies enabled by the internet. This has helped to streamline organisation processes and enhanced the productivity of managers because of the online real time communication with their employees. Also, the employees can communicate more efficiently, by obtaining and responding to information and queries promptly via the internet (Long, 2016). The internet technology equally supports and promotes different work styles like, flexible work arrangements, open-office environments, telecommuting schedules, compressed work weeks, and teleconferencing facilities (Brough and O'Driscoll, 2010; McElroy and Morrow, 2010; Leslie *et al.,* 2012; Golden, 2013; Hing Lo, *et al.,* 2014; Gajendran *et al.,* 2015).

3. IMPLICATIONS FOR EMPLOYEES

Technology has become an indispensable tool for all organisations including FM in the globalised economy (Peppard and Ward, 2004). However, Ebbeson (2015) and Kandampully *et al.* (2016) argued that not all organisations derive competitive advantage through technology because the added-value that technology offers depends on a variety of factors that involves the employees. Therefore, an assessment of the impact of technology on the employee, given the significant investment and expected opportunities in technological innovations, cannot be

out of place (Nyheim and Connolly, 2011; Bilgihan, Okumus and Cobanoglu, 2013; Kauffman, Liu and Ma, 2015). This section examined the implication that each of the technological innovations have on the employees.

Robots are rapidly replacing employees in most jobs (Nakagawa 2015; West, 2015). For instance, West (2015) argued that with the aid of technological innovation, many organisations have achieved economies of scale with few employees. West (2015) further writes that Google, which was worth $370 billion in 2014 only had about 55,000 employees which is less than a tenth of the size of American Telephone and Telegraph (AT&T) workforce in 1960s due to technological innovations. Also, most of the robots are fitted with capabilities that further forecloses the need for human assistance like self-recharging capabilities. This enables the robots to automatically recharge themselves when they experience a drop in their battery level to 60% without needing human supervision. These smart robots help in reducing overheads on labour. Therefore, with increased adoption of robots in FM practice, job displacements at every level of FM is a given.

The adoption of sensors threatens the chances of survival of the tactical level of FM because most building fittings that are monitored by sensors will not require the supervisory role of the tactical level FM as the building fittings fitted with sensors are programed to report any fault or out-of-specification conditions to the remote monitoring point. Sensors have also been attributed with the capacity for effective employee monitoring by which organisation can maximise employee's time and increase efficiency (Yerby, 2013; Roth, 2017). However, there are legal and ethical issues around employee monitoring which the facilities managers must prepare to grapple with as the adoption of sensors in organisations continue to rise, and employee privacy advocates continue to seek reforms for greater protection of the employees (Yerby, 2013).

The ability of the drone technology to access difficult and risky building areas holds a double implication for employees. While it translates to an improvement in the safety practice of FM because of the numerous deaths caused by falls from heights (Bobby, 2017), it also promotes huge job loss in the scaffolding services of operational FM (Hounsell, 2016). With the advancement of the internet, scholars and professionals have recognised some unfavourable effects on employee well-being (Golden, 2013) especially during off-work hours and the subsequent impact on work-life balance (Hoeven *et al.*, 2016). Employees face social isolation, alienation, lack of organisational visibility, intrusion of work into home life and overwork as a result of some forms of technological innovation (Grimshaw, 2007).

4. IMPLICATIONS FOR SOCIAL SUSTAINABILITY

The Brundlandt Commission defined sustainable development as "development which meets the needs of the present without comprising the ability for future generations to meet their own needs" (WCED 1987, p.43). It can be argued that the use of the term "needs" in the Brundtland definition of sustainability, summarises the interplay of society and nature (Littig, and Grießler, 2005). If "needs' is analysed in the context of paid employment, then employment will allow the people to meet their needs. Employment in the broadest sense plays an essential role in sustainability because of the ability to fulfil basic needs that the employees derive. However, gainful employment is one of the foremost organisational and structural principles of society, which has continued to experience transformation over time (Fischer-Kowalski and Haberl, 1993). Employment in modern working societies, especially paid employment, has

transformed beyond ensuring that people have access to a livelihood to satisfy their needs, towards becoming the means of stratifying and structuring society (Senghass-Knoblauch, 1998). Hence, paid employment is regarded as a factor of social sustainability that mediates the nature-society relationship, because it is the way by which an extended set of human needs are met and the society's reproductive capabilities are upheld (Littig, and Grießler, 2005). Furthermore, it is expected that the concept of social sustainability in an organisation reflect elements of social welfare (DIW *et al.,* 2000; HBS 2001; Brandl and Hildebrandt, 2002) that not only secure employees' income but also promotes integration and social cohesion (Senghass-Knoblauch, 1998). The implication of increased digitisation in FM has affected employment as seen from the earlier literature on the technological innovations. Consequently, it may be argued that if employment is a factor of social sustainability, and it is significantly affected by technological innovations in FM, then there is need to evaluate our sustainability practice in the face of technological advancement.

5. DISCUSSION

FM has grown over time from the cost cutting level to the stage of measuring the impact of its activities on the society. However, the impact of technological innovation appears to be at variance with the growth in FM profession. Adoption of technological innovations in FM has continued to be aligned with the streamlining of business processes and the management of cost efficiency (Becker, 1990; Alexander, 1992; Alexander, 1994; Price, 2000; Pitt and Hinks, 2001). This is reminiscent of the first generation of FM practice when the profession was working in isolation to the organisation (Pathirage *et al.,* 2008). There is a narrow view of technological innovation capability in FM because issues that are fundamental to the management of the facility beyond cost optimisation are not considered (Dommelin *et al*., 1990). There appears to be a contention between the effects of technological innovation in FM and the current state of development of FM practice. While the technological innovations are streamlining business processes and cutting costs through job losses, FM has grown to the level of measuring how its operations impact society. Moreover, the information that is generated from the use of technology, just like the first generation of FM cannot be really optimised towards predicting value addition in the organisations. Therefore, there is a need for a broader perspective of FM strategy and operation when considering the adoption of technological innovations where the integration of people, process, and place will be the utmost consideration (Rondeau *et al*., 1995; Alexander, 1996; McGregor, 2000) and the consideration of the impact of FM activities beyond the micro level of the building to the macro level of the society will be paramount (Price, 2002; Alexander and Brown, 2006; Michell, 2013).

6. CONCLUSION

Technological innovation has shaped FM practice greatly. However, there is a need to constantly evaluate and align its impact with the current level of development in the profession, not forgetting the fundamental principles of integrating people, place, process and technology. This will require the academicians to research into some of the contemporary challenges that have come up with the use of technology. Especially as it relates with the employees to have a holistic perspective that is not only profit driven but socially sustainable. This paper represents a preliminary study of an ongoing research in this regard.

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