

13TH INTERNATIONAL

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**FOREWORD**

Welcome to the 13th International Postgraduate Research Conference (IPGRC 2017) hosted by the School of the Built Environment at University of Salford, UK. This year’s IPGRC is organised as part of the International Research Week 2017- ‘Shaping Tomorrow’s Built Environment: Construction and Design for the Modern World’ and also the year we celebrate the 50th anniversary of Salford as a University, which makes this year’s conference very special. This conference creates a unique opportunity for researchers from Salford and other parts of the world to share their research interests, and outputs and to network and interact within a professional and friendly environment, with high profile academics and leaders within the built environment.

This year’s conference brings together participants from a number of countries including the UK, USA, Australia, New Zealand, Canada, Sri Lanka, Hong Kong, Iran, Italy, Ireland, Norway, India, Brazil, South Korea, Nigeria, Turkey, UAE, South Africa, Iraq, Ghana, Estonia, Saudi Arabia and many more. The conference received over 100 papers and posters covering the following themes:

• Business, Economics and Finance

• Property and Project Management

• ICT, Technology and Engineering

• People, Skills and Education

• Design and Urban Development

• Sustainability and Environmental Systems

Conference will provide a forum for novel discussions into the development and application of new and emerging practices to challenge current design and construction practice in the areas of people, process and technology issues. On behalf of School of the Built Environment, the conference co-chairs and organisers, we wish you an enjoyable and fruitful experience. We hope that you will obtain useful feedback to your research work, gain insight from work of others and forge connections for future.

**Dr. Chaminda Pathirage**

Conference Chair

Director of Postgraduate Research Studies

School of the Built Environment

University of Salford

United Kingdom

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**TECHNOLOGICAL INNOVATION AND FACILITIES MANAGEMENT PRACTICE: IMPLICATIONS FOR SOCIAL SUSTAINABILITY**

**U.J. Adama1 and K.A. Michell1**

*1 UCT–Nedbank Urban Real Estate Research Unit, Department of Construction Economics and Management, University of Cape Town, Private Bag X3, Rondebosch, 7701, South Africa*

Email: ADMUNE001@myuct.ac.za

**Abstract:** This study evaluates social sustainability in facilities management (FM) organisations against the backdrop of advancement of technological innovations. Past studies have revealed that the practice of sustainability in FM is not holistic. A greater emphasis is placed on the economic and environmental pillars of sustainability to the exclusion of the social pillar. This exclusion is attributed to the inability to reach a consensus on what constitutes a social sustainability construct in light of the diverse elements of social sustainability. The study is explorative and relied on available literature on social sustainability integrated with FM literature. The author argues for the promotion of social sustainability in FM through the integration of three constructs of social sustainability, namely: social relationship, job satisfaction; knowledge development; and several other sub-indices. These constructs are seen as a starting point towards evaluating social sustainability practice in FM. The study proposed a social sustainability framework towards enhancing the understanding of social sustainability in FM practice. The framework suggests that an organisation’s commitment to the promotion of social sustainability practice could result in optimal delivery of the core business objectives of the organisation. The framework provides useful direction for further studies in this research area.

**Keywords**: Facilities management, social sustainability, sustainable facilities management, sustainability, technological innovation.

1. **INTRODUCTION**

Technological advancement has brought a variety of possibilities to the built environment. Hence, FM is engaging in the adoption of new technologies to both transform and improve the overall triple bottom line of organisations. The common types of technological innovations that are adopted in FM practice include: Information Communication Technology (ICT), Radio Frequency Identification (RFID), cloud-based technology, drone technology, social media technology, robots and sensors. The adoption of these technological innovations has assisted in promoting the efficiency, profitability, flexibility, corporate image, connectivity and reduced the overall cost of doing business. However, previous studies argued that these technological innovations have changed the work patterns in organisations resulting in a negative impact on employees. For instance, employees' social well-being is affected by ICT-based technological innovations (Hing Lo *et al.,* 2014; Jiang, 2016; Hoeven *et al.,* 2016). The technologically induced work pattern causes employees to face social isolation, alienation, partial invisibility in the organisation, coupled with overwork and the intrusion of work into employees’ home life (Grimshaw, 2007). Furthermore, employees face job losses due to the introduction of robots (West, 2015). The introduction of RFIDs in organisations results in a violation of employees’ privacy and security, in addition to labour intensification (Fisher and Monahan, 2008; Azevedo and Carvalho, 2012). Fisher and Monahan (2008) further argued that both surveillance and labour intensification can bring about additional stress and an overall decline in employees’ morale. The challenges highlighted above have a social dimension and resultant implications for the social wellbeing and sustainability of the employees. There is a need for concrete action else, the quality of employees and social capital that will be available to organisations in the future will not be able to guarantee organisational success (Abbott, *et al.,* 2013). Moreover, Ware *et al.* (2017) argue the importance of evaluating how these social problems affect workforce productivity, innovation, and employment relationships on a sustainable basis.

International Facilities Management Association (IFMA) (2014) stated that sustainability is crucial to FM practice. However, there has been an increased demand for a holistic view of sustainability due to the imbalance in the application of the economic, social and environmental pillars of sustainability (Elmualim *et al.,* 2008; Jensen *et al.,* 2013). The social pillar which represents the people’s concerns (Omann and Spangenberg, 2002) among the sustainability pillars has suffered continuous neglect despite the benefit that is derivable from exploring peoples’ potential (Omann and Spangenberg, 2002; Sarpin, 2015). This is a gap in the practice of sustainable FM. Hence, this study explores the impact of technological innovations on FM practice and the influence on social sustainability by reviewing and integrating available literature on FM and social sustainability. The study adopted three constructs, namely: social relationship, job satisfaction and knowledge development to measure social sustainability against the backdrop of technological innovations in organisations. The strategy of the study is first, to carry out an overview of how technological innovation has influenced FM practice as evidenced in the literature. In addition, to investigate how the emerging FM practice influences social relationship, job satisfaction and knowledge development as measures of social sustainability.

**2. INFLUENCE OF TECHNOLOGICAL INNOVATIONS IN FM PRACTICE**

Technological innovations in this study includes cutting-edge technologies that are being adopted by FM professionals, for improved service delivery. These include: information communication technology (ICT), cloud-based technology, drone technology, robotics and the social media. These classes of technological innovations have provided opportunities for organisations to optimise employee capabilities, and respond efficiently to customer needs, gain valuable feedback, ideas and useful information (Lindkvist and Elmualim, 2009; Martin and Omrani, 2015; Kandampully *et al.,* 2016). From previous studies, the influence of technological innovations in FM practice includes: effective job performance, innovative work practices, operation of “Virtual Office” and the development of green buildings, increased commitment of employees, job flexibility, and greater task involvement (Huselid and Becker, 1996; Nutt, 2000; Grimshaw, 2005; Osterman, 2006; White and Bryson, 2013; Martin and Omrani, 2015). Furthermore, the adoption of technological innovation has transformed FM practice from being reactive to proactive, and with increased sophistication in technological innovations towards being predictive (Taival, 2017). More specifically, technological innovations like the Building Information System (BIM) has transformed operational FM. BIM is a tool used by architects to create a complete model of building before it is built. It enables the facilities manager to visualise the building in the pre-construction stage and make informed contributions at the design stage that will enhance the overall performance of the building throughout the building life cycle. BIM has also promoted enhanced communication by making data sharing flexible among the facilities maintenance managers in a building (Taival, 2017).

The drive towards “Smart building” is boosted by the integration and control of the different systems in a building facility like heating, lighting, ventilation, sanitation and security from one central point using technological innovations. From such point, smart sensors are used to detect and rectify inefficiencies like a leaky tap or a light that has been left on. This, has enhanced the practice of sustainable FM through the effective management of energy, water and waste. Furthermore, the internet and other wireless technologies have enabled FM productivity and efficiency on a sustainable basis. For instance, the virtual office is made possible by the internet. When applied to the transportation logistics, internet connectivity has helped FM professionals to determine and optimise the most fuel-efficient routes for transport services amongst others. The availability of different censors has enabled effective remote monitoring and control using alarm monitoring and services in FM practice (Taival, 2017).

The use of automated devices and smart robots have also helped to transform FM practice in several ways. Robots are increasingly being deployed in FM sector for portering, security, waste management, building maintenance services, logistic deliveries, catering and customer services etc. These were services hitherto undertaken by human beings with all the associated overhead costs. Moreover, the increased use of robots in FM has reduced the energy cost and increased management efficiency. In the same manner, drones fitted with a camera can carry out efficient building survey assessment, do video and thermal imaging especially at a high level or high-risk areas thereby reducing the risk of falls associated with such tasks (Marginalia, 2016). Drones for FM services also known as "Aerial FM", can diagnose and record on video, the condition of roof defects, storm damages, and weathering issues in a quick and cost-efficient manner (Marginalia, 2016).

The adoption of technological innovations like computer-aided facilities management (CAFM) software has also increased the level of integration amongst employees and departments in FM organisations and promoted business operation on a sustainable basis. For instance, the integration of (CAFM) software removes ambiguity by ensuring that contractors and employees are using the same data set and methods over any contractual activity. Furthermore, smartphones, cloud computing and social media have increased the mobility of the FM services whereby facilities managers can conduct their operations from anywhere in the world. Cloud-based technology has promoted the unification of management in multiple geographically dispersed facilities, with immense capacity to store historic and current maintenance data about the facility (Lau *et al.*, 2013). The smartphones and social media technologies enable video conferencing, multimedia instant messaging, recording and photographing, which enables facilities managers to carry out their assignment from any remote location without necessarily visiting the site. Hence, technological innovation has influenced the practice of FM over the years. However, the impact of technological innovation in FM organisation is on the core business and the employees, but little is known about the impact on the employees as they are rarely discussed. This has made the discussion of technological innovation impact in FM not holistic. Since organisations are required to act sustainably, it therefore, has become important to assess the influence of technological innovation in the organisation holistically.

**3. SUSTAINABLE FM PRACTICE**

There is a growing interest in sustainable FM practice, especially with respect to evolving new strategies that will enhance the skills of facilities managers towards meeting sustainability criteria (Nielsen *et al.,* 2009; Sarpin, 2015). This is apparent as a result of the critical role that the facilities managers play throughout the entire facility life-cycle (Elmualim *et al*., 2008). Previous studies emphasised the possibility of deriving substantial benefits from sustainable FM practice (Hodges 2005; Lai and Yik 2006; Nielsen *et al*. 2009) because facilities managers have a growing influence on the profitability, productivity, energy management, waste management, employee wellbeing and public perception of organisation (Pitt, 2005; Shah, 2007). Brown and Pitt (2001) argued that the growth in the built environment practice and the consequential growth of the FM sector is expected to be significant and will impact on all aspects of sustainability. However, the practice of sustainable FM has not reflected a holistic approach because previous sustainable FM studies have been more favourable to the economic and environmental issue with little effort being directed towards the social issues. Sustainability comprises three pillars: economic, environmental and social that should be in equilibrium for sustainability to be holistic (Hodges 2005; Dillard and King, 2008; Teodorescu, 2015). In other words, the impact of one of the components is felt by the other two at any given time because of their interrelatedness. It further implies that there is an unbreakable relationship existing among the pillars of sustainability. However, Elmualim (2009), Vallance *et al.* (2011) and Jensen *et al.* (2013) all argued that the social pillar of sustainability has received the least attention. In a similar submission, the European Council (2001) affirmed that “at best social sustainability is mentioned separately including social objectives, but not fully integrated into the sustainability framework”.

Elmualim *et al.* (2009) argued that a balanced sustainability policy should integrate all the elements of the triple-bottom line (TBL). Elkington (1998) asserts that the essence of the TBL is to compel organisations to be more responsive by shifting their focus from wholesome economic pursuits toward some social and environmental concerns while conducting their business. An organisation (FM) is a social function (Ohmae, 1999; Gao and Zhang, 2006) that should not only be responsible for the well-being of its shareholders alone but ensures that its employees, customers, suppliers, local communities and the society enjoy security and a sustainable good life (Deegan, 2002; Gao and Zhang, 2006). Vanclay (2004) argued that although FM organisations are adopting the concept of TBL in their development and operations, a clear social dimension as a measure for the attainment of social sustainability is still unclear. Social sustainability is fundamental to sustainable FM practice because the performance of building designs and social infrastructure including access to services and recreation have a direct effect on the quality of life and wellbeing, and the cohesiveness of society (construction industry research and information association) (CIRIA, 2006). Therefore, the inability to fully integrate the economic, social and environmental issues in FM is a gap in FM knowledge (Sarpin 2015).

Vanclay (2004) suggested the integration of stakeholders’ interest as a starting point for measuring social sustainability. Other studies like Wehling (1999) suggested combining both objective and subjective indicators of people as a measure of their social sustainability. This study combines the two positions, by adopting the employees in FM organisations as stakeholders that represents the society for testing social sustainability practice. This is because employment is

 a factor of social sustainability that mediates nature-society relationship. Therefore, when employees can meet their needs and other extended sets of human needs, the society’s reproductive capabilities are sustained (Littig and Grießler, 2005). The study adopted three main constructs of social relationship, job satisfaction and knowledge development and several sub-indices as shown in Table 1 as social sustainability indicators. The inter-relationship of these constructs and sub-indices led to the formulation of social sustainability framework as shown in Figure 1. It is acknowledged that the subjective nature of social sustainability factors will negate having a set of constructs as absolute for its study. Therefore, this study ensured that the sub-indices that constituted the three main constructs have direct bearing on employees’ wellbeing and comfort. Furthermore, the study recognises that organisations contribution to their host community is a form of social sustainability practice that is well established in literature. However, it should be noted that the intention of the current study is to evaluate such contribution through the employees as representatives of the community. Hence, the premise of the study is that the employees’ experiences whether positive or negative has an influence on the social wellbeing of the community and therefore on society as a whole.

**4. THE CONCEPT OF SOCIAL SUSTAINABILITY**

The sustainability concepts of the Brundtland report (WCED 1987) and the Rio documents (UN, 1992) required that the environmental, economic, social, factors be equally combined (Littig and Grießler, 2005). These different factors are referred to as "dimensions" or "pillars" of sustainability. In order for sustainability to be operationalised, the individual pillars/dimensions must be related to each other in more concrete terms. Kopfmüller *et al.* (2001) categorised the operationalisation of sustainability as either a one-pillar model or multi-pillar models. The one-pillar model prioritises the environmental dimension on the basis that, sustainability should essentially help to preserve the environmental systems and resources which are necessary for economic and social life as an important requirement for meeting the future needs of humanity (Littig and Grießler, 2005). However, the three-pillar model which is more recognised internationally emphases an equal treatment of the environmental, economic, and social goals of sustainability. The proposition is that human needs are beyond merely providing an environmentally stable and healthy environment, but in addition social and cultural needs should be addressed (Littig and Grießler, 2005). In another argument, it was stressed that the environmental, economic, and social needs are three individually connected systems, which must remain stable so as not to endanger the successes of progressive development.

Sustainability in FM has traditionally been evaluated in terms of the environmental pillar. Wackernagel (2001) argued that human well-being is essential for the well-being of a society. In a contrary view, Hodge and Hardi (1997) expressed the interdependence of people and their surrounding world by stating that the achievement of progress toward sustainability will require maintaining and improving, both human and environmental wellbeing, and not one at the expense of the other. Furthermore, Brandl (2002) argues that sustainability is the relationship between environmental and social elements which needs to be maintained in such a way that it doesn’t destabilise the whole system: "From a system theoretical point of view, this approach aims to uphold both the functionality and the resilience of linked sub-systems, thus keeping the whole system stable" (Brandl 2002, p.13ff, transl. by Littig and Grießler, 2005). Evaluating the definition of sustainable development by the Brundlandt Commission 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, summaries the interplay of society and nature (Littig and Grießler, 2005). Within the context of nature, the needs of human beings are challenging to nature because of the emission of gases and generation of waste and alteration of the ecological systems associated with the exploitation of natural resources. However, if the meaning of "needs" is expanded within the context of paid employment, it includes the quest for education, recreation/leisure, social relationships, and self-fulfilment. The satisfaction of these needs will call for a much broader scope of action and opportunities. In this study, we defer to the latter option, because by meeting these needs, employees will be able to take responsibility for shaping a decent life for themselves and the society.

Employment in the broadest sense plays an essential role in sustainability because the fulfilment of needs derived from employment requires some exchange between society and nature. Moreover, 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). However, work in modern working societies, especially paid employment, has transformed beyond ensuring that people get a livelihood to satisfy their needs, towards becoming the means to stratify and structure society (Senghass-Knoblauch, 1998). Therefore, employment has become a factor of social sustainability that mediates the nature-society relationship, by reflecting the way that an extended set of human needs are met and the society’s reproductive capabilities for a long period are promoted through social justice, human dignity and participation. Furthermore, it is expected that the concept of social sustainability in an organisation reflect elements of social welfare (Brandl and Hildebrandt, 2002) that not only secure employees’ income but also promote integration and social cohesion (Senghass-Knoblauch, 1998). Based on these social sustainability concepts discussed above, this study adopted a set of three core indicators to assess the social sustainability in FM practice. The first construct is ‘social relationship’ which measures alienation, social network, work and home life balance, overwork and social isolation. The second social indicator deals with ‘job satisfaction’ which assesses job indices like remuneration, autonomy, job security, interaction, professional status, task requirement and organisational policy. The third social sustainability construct adopted in this study deals with ‘knowledge development’. Knowledge development evaluates the level of workshops and seminars, professional development programs, retirement development plans and on-the-job training in organisations. Each of these will be discussed briefly below.

**4.1 Social Relationship and Social Sustainability**

Social relationship refers to any connection with at least one or more people that act harmoniously in a social situation. Alienation as a factor of social relationship involves estrangement from the larger social world. From the analysis of Marx’s early writings, occupational alienation can be in the form of lack of control over ones’ labour and the lack of control over ones’ process of work are factors of occupational alienation. Therefore, the new order of work pattern due to technological innovation in organisations encourages occupational alienation because technology in most cases takes control over work processes (Bailey and Kurland, 2002; Kurland and Cooper, 2002; Grimshaw, 2007; Osin, 2009; Dempsey *et al.*, 2011; Rey, 2012; Nam, 2014; Mokyr *et al.*, 2015; Nørgaard *et al.*, 2015; Valtorta, 2016; Zhang, 2016). ICT promotes more virtual connectivity than physical connectivity which has affected social networks. Social networks are characterised by the joint activities of, and constant exchanges between, members in an organisation or a social system. This reflects the state of recurrent relationship that connects the actors in a social system (Bhatt 2001; Grimshaw, 2007; Bennett *et al.*, 2010; Dempsey *et al.*, 2011; Nam, 2014; Zavaleta, 2014; Valtorta, 2016). Also, the increased adoption of technological innovation because of globalisation has blurred the boundaries between work life and home life (Allen *et al.,* 2000; Frone, 2003; Galinksky *et al.,* 2004; Wallace, 2004; Wajcman, *et al.,* 2008; Grimshaw, 2007; Nicholas and Guzman, 2009; Beutell, 2010; Nam, 2014; Fapohunda, 2014; Mokyr *et al.*, 2015; Nørgaard *et al.,* 2015; Valtorta, 2016; Zhang, 2016)). A poorly managed balance between work and home life has been associated with stress, sub-optimal productivity and high absenteeism. However, employees with better work and home life balance are reported to have a better sense of responsibility, ownership and control of their work life. Employees have demonstrated greater commitment and loyalty to organisations that help them balance their work and home-life (Thompson *et al.,* 1999; Allen, 2001; Clark, 2001; Behson, 2002, 2005).

Overwork as a sub-index of social relationship is one of the factors that is responsible for workplace stress (Eikhof *et al.*, 2007; Grimshaw, 2007; Nam, 2014; Valtorta, 2016). The resultant tress created by overwork negatively influence workers’ health and well-being and in turn a negative impact on the productivity and profits of the organisation (Bickford, 2005). In a similar submission, The National Institute for Occupational Safety and Health (NIOSH) (1999) confirmed that the health of workers, and in turn, the health of organisations faces a threat from job stress due to the changing nature of work. It follows therefore, that, inefficient management of over work induced stress can result in sick and socially unsustainable society because workers will be spending their resources on health care challenges. Social isolation is the opposite of social inclusion. An organisation is presumed to pursue social inclusion when formal and informal social events at work are perceived as equally appropriate for employees (Beehr *et al.*, 2000; Cattan *et al.,* 2005; Marshall *et al.,* 2007; Casper, *et al.,* 2007; Dempsey *et al.,* 2011; Nam, 2014; Zavaleta *et al.,* 2014; Nørgaard *et al.*, 2015; Valtorta 2016). This is important in the promotion of social sustainability in light of previous studies on social identity theory which argues that people classify themselves into in-groups and out-groups using salient measures, while looking out to maintain a positive social identity in the process (Brewer, 1979; Tajfel and Turner, 1986). FM is a relationship management oriented profession with enormous responsibility to people, place and planet (Grimshaw, 2007; Ware *et al.,* 2017). Moreover, FM has to evolve new ways of operation that favours not only the shareholders of the organisation but also promoting positive community life (Kasim and Hudson, 2006).

* 1. **Job Satisfaction and Social Sustainability**

As earlier mentioned, employment is a factor of social sustainability that mediates the nature-society relationship, by reflecting the way that an extended set of human needs are satisfied. Therefore, job satisfaction for the employees becomes critical. Lance (1991) and Irvine and Evans (1995) in previous studies argued that a significant relationship exists between a low level of job satisfaction and the rate of employee turnover. Hence, job satisfaction is a buffer against conditions that encourage a high level of employee turnover. In a similar submission, van Saane *et al.* (2003) argued that job satisfaction also serves as a barrier to occupational stress, which is a factor that negatively affects social sustainability. Previous studies have identified social sustainability factors that influence job satisfaction to include: remuneration, autonomy, job security, interpersonal relationship, professional status, task requirement and organisational policy (Beehr *et al.,* 2000; Bhatt, 2001; Grimshaw, 2007; Bennett *et al.*, 2010; Dempsey *et al.,* 2011; Nam, 2014; Mokyr *et al.,* 2015; Nørgaard *et al.,* 2015; Zhang, 2016).

* 1. **Knowledge Development and Social Sustainability**

Kandampully (2002) acknowledged that technological innovation has created a knowledge dimension to almost every manual job. Hence, organisations seek employees that are able and willing to update their knowledge on a continuous basis (Bhatt, 2001; Wiewiora *et al.,* 2010; Ware, 2003;Dempsey *et al.,* 2011). Unlike the old practice, experience is of limited value because new knowledge is required to be productive with new technology (Kandampully, 2002; Pathirage *et al.,* 2008). Drucker (1993) and Nutt (1999) argued that the ability of the employees and organisations to be proactive in seeking current knowledge is the only means through which organisations can be sustainable. Nutt (2000) further affirmed that knowledge development is the foundation for synchronising organisation objectives with the facilities objective. In the context of sustainability, Bhatt (2001) maintained that the development of employees’ knowledge should be regarded as significant in terms of the adoption of technological innovation in organisations. Sarpin (2015) further argued that the knowledge gap has remained a challenge to the practice of holistic sustainable FM. Hence, the upgrading of people’s knowledge has a correlation with their wellbeing, which is fundamental factor in social sustainability.

**5. TOWARDS THE PROPOSED SOCIAL SUSTAINABILITY FRAMEWORK FOR FM**

As earlier stated, the study has evaluated social sustainability through the three concepts of social relationship, job satisfaction, and knowledge development. The systematic search of past literature on social sustainability between years 2000-2016 yielded sixteen factors with direct bearings on the employees’ wellbeing, which are described as social sustainability indicators in the literature. These factors were grouped into the three main constructs for conciseness as shown in Table 1 below.

*Table 1: Social sustainability constructs from the literature*

|  |  |  |
| --- | --- | --- |
| **Construct**  | **Social sustainability indictors** | **Author**  |
| Social relationship  | Alienation  | Bailey and Kurland, (2002); Kurland and Cooper (2002); Grimshaw (2007); Osin (2009); Dempsey *et al.* (2011); Rey (2012); Nam (2014); Mokyr *et al.* (2015); Nørgaard *et al.* (2015); Valtorta (2016); Zhang (2016) |
| Social network | Bhatt (2001); Grimshaw (2007); Bennett *et al.* (2010); Dempsey *et al.* (2011); Nam (2014); Zavaleta (2014); Valtorta (2016) |
| Work/home life balance | Nicholas and Guzman (2009); Wajcman, Bittman and Brown (2008); Wallace (2004); Allen *et al.* (2000); Frone (2003); Grimshaw (2007); Beutell (2010); Nam (2014); Fapohunda (2014); Mokyr *et al.* (2015); Nørgaard *et al.* (2015); Valtorta (2016); Zhang (2016) |
| Overwork  | Eikhof *et al.* (2007); Grimshaw (2007); Nam (2014); Valtorta (2016) |
| Social isolation | Beehr *et al.* (2000); Cattan *et al.* (2005); Marshall *et al.* (2007); Grimshaw (2007); Dempsey *et al.* (2011); Nam (2014); Zavaleta *et al.* (2014); Nørgaard *et al.* (2015); Valtorta (2016) |
| Job satisfaction  | Remuneration  | Nørgaard *et al.* (2015); Mokyr *et al.* (2015) |
| Autonomy  | Nørgaard *et al.* (2015) |
| Job security | Grimshaw (2007); Dempsey *et al.* (2011); Mokyr *et al.* (2015); Nørgaard *et al.* (2015) |
| Interpersonal relationship  | Beehr *et al.* (2000); Bhatt (2001); Bennett *et al.* (2010); Nam (2014); Nørgaard *et al.* (2015); Zhang (2016) |
| Professional status | Nørgaard *et al.* (2015) |
| Task requirement | Nam (2014); Nørgaard *et al.* (2015) |
| Organisational policy | Grimshaw (2007); Nørgaard *et al.* (2015) |
| Knowledge development | Workshop and seminars | Bhatt (2001); Dempsey *et al.* (2011) |
| Professional development program | Ware (2003) |
| Retirement development plan | Wiewiora *et al.* (2010) |
| On-the-job training | Bhatt (2001); Wiewiora *et al.* (2010);Dempsey *et al.* (2011) |

Based on the on the number of times that each of the constructs in Table 1 were cited in the literature, a tentative ranking, from a theoretical point of view, of the constructs was generated in Table 2 to show the frequency of each of the sub-indices under the main construct based on the emphasis placed on them in previous studies. The tentative ranking in Table 2 indicates that over the years under review (2000 – 2016), out of the 69 references made to social sustainability, 44 of those references were in relation to social relationship, 18 were related to job satisfaction and 7 were related to knowledge development. The authors perceive that this could be indicative of the relative importance of these factors that may require further empirical study to substantiate.

*Table 2: Strength of each sub-constructs by frequency and ranking*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Construct** | **Social sustainability indictors** | **Frequency** | **Ranking** | **Overall Ranking** |
| Social relationship | Work/home life balance | 13 | 1st | 1st |
| Alienation  | 11 | 2nd | 2nd |
| Social isolation | 9 | 3rd | 3rd |
| Social network | 7 | 4th | 4th |
| Overwork | 4 | 5th | 6th |
| Job satisfaction  | Interpersonal relationship | 6 | 1st | 5th |
| Job security | 4 | 2nd | 6th |
| Remuneration  | 2 | 3rd | 8th |
| Task requirement | 2 | 3rd | 8th |
| Organisational policy | 2 | 3rd | 8th |
| Autonomy | 1 | 4th | 9th |
| Professional status | 1 | 4th | 9th |
| Knowledge development  | On-the-job training | 3 | 1st | 7th |
| Workshop and seminars | 2 | 2nd | 8th |
| Professional development programRetirement development plan | 1 | 3rd | 9th |
| 1 | 3rd | 9th |
|  | 69 |  |  |

Subject to further empirical analysis, organisations that seek to promote social sustainability may need to pay more attention to the factors of ‘social relationship’ as, in terms of the literature, these seen as being more important to the employees than job satisfaction and knowledge development.

**6. THE PROPOSED SOCIAL SUSTAINABILITY FRAMEWORK**

This paper aims to provide a critical view of the changes that the introduction of technological innovation will cause to the employees in an FM organisation. Although the introduction of technological innovation in FM organisation will affect both the core business and the employees of the organisation as shown in Figure 1, as earlier stated, this study will concentrate on the employees as being indicative of the community and society. The conceptual framework in Figure 1 consists of five parts: firstly, the FM organisation; secondly, the technological innovation which is perceived as the external enabler that is adopted into the organisation. Thirdly, the core business to the left of the framework, and fourthly, the employee to the right of the framework. They are both impacted by the effect of any technological innovations that are adopted into the organisation. Lastly, social sustainability which is the point of the interrelationship between the FM organisation and society.



*Figure 1: Proposed framework for social sustainability in FM*

**7. CONCLUSION**

Technological innovations have influenced the practice of FM profoundly by helping to promote efficiency, profitability, flexibility, corporate image, connectivity and reduced the overall cost of doing business. It has also helped to improve safety and competitiveness. However, more benefits may be possible if the organisations explored the social sustainability of the employees. Organisations that will survive the global business competition in view of the technological advancements are those that will be more socially inclined to promoting employees’ welfare. The study revealed from the analysis of literature searched, the most probable constructs for promoting social sustainability are the social relationship construct, the job satisfaction construct, and the knowledge development construct. It is further concluded that further empirical research is required to ascertain the relative importance of each of these constructs. Lastly, it may be concluded that facilities managers, in adopting technological innovations in their practice, should not only evaluate the advantages for the core business alone but also understand how the adoption thereof will impact on the social dimension of sustainability. This paper represents a preliminary stage of a comprehensive ongoing study in this regard.

**8. REFERENCES**

Allen, T. (2001) Family-supportive work environments: The role of organizational perceptions. *Journal of Vocational Behavior*. 58, pp.414–435.

Allen, T. D., Herst, D. E. L., Bruck, C. S., and Sutton, M. (2000) Consequences associated with work-to-family conflict: A review and agenda for future research*. Journal of Occupational Health Psychology.*  5(2), pp.278–308.

Andrew W. Brown, M.R. Pitt, (2001) Measuring the facilities management influence in delivering sustainable airport development and expansion. *Facilities,* 19 (5/6), pp. 222-232, doi: 10.1108/02632770110387814

Azevedo, S. G. and Carvalho, H, (2012) Contribution of RFID technology to better management of fashion supply chains. *International Journal of Retail & Distribution Management*, 40(2) pp. 128 – 156

Bailey, D. E., and Kurland, N. B. (2002) A review of telework research: Findings, new directions, and lessons for the study of modern work. *Journal of Organizational Behavior*. 23, pp.383-400.

Beehr, T. A., Jex, S. M., Stacy, B. A., and Murray, M. A. (2000) Work stressors and co-worker support as predictors of individual strain and job performance. *Journal of Organizational Behavior*, 21, pp.391- 405.

Behson, S. J. (2002) Which dominates? The relative importance of work-family organizational support and general organizational context on employee outcomes. *Journal of Vocational Behavior,* 61, 53–72.

Behson, S. J. (2005) The relative contribution of formal and informal organizational work-family support. *Journal of Vocational Behavior*, 66, 487–500.

Bennett, J. Owers. M., Pitt, M., Tucker, M. (2010) Workplace impact of social networking. *Property Management*. 28(3), pp.138 – 148.

Bhatt, D. G. (2001) Knowledge management in organizations: Examining the interaction between technologies, techniques, and people. *Journal of Knowledge Management*, 5(1), pp.68-75.

Brandl, S. (2002) Konzepte sozialer nachhaltigkeit im deutschen diskurs', in Ritt, T. (Ed.): Soziale Nachhaltigkeit: Von der Umweltpolitik zur Nachhaltigkeit? Arbeiterkammer Wien, Informationen zur Umweltpolitik 149, Wien, pp.11-32.

Brandl, S. and Hildebrandt, E. (2002) Zukunft der Arbeit und soziale Nachhaltigkeit, Zur Transformation der Arbeitsgeselischaft vor dem Hintergrund der Nachhaltigkeitsdebatte, Leske und Budrich, Opladen.

Brewer, M. (1979). In-group bias in the minimal intergroup situation: A cognitive-motivational analysis. Psychological Bulletin, 86, 307–324.

Cattan, M., White, M., Bond, J., and Learmouth, A. (2005) Preventing social isolation and loneliness among older people: A systematic review of health promotion interventions. *Ageing and Society*, 25, pp.41–67.

Casper, W. J., Eby, L. T., Bordeaux, C., Lockwood, A., and Burnett, D. (2007). A review of research methods in IO/ OB work-family research. *Journal of Applied Psychology*, 92(1), 28–43.

Clark MS. Social relationships in adulthood. In: Baltes PB, Smelser NJ, eds. International encyclopedia of the social & behavioral sciences. Oxford: Pergamon, 2001:14423–9

Cooper, C. D. and Kurland, N. B. (2002) Telecommuting, professional isolation, and employee development in public and private organizations. *Journal of Organizational* *Behavior.* 23, pp.511-532.

Dempsey, N., Bramley, G., Power, S., and Brown, C. (2011) The social dimension of sustainable development: defining urban social sustainability. *Sustainable Development*. 19, pp.289-300.

Dillard, J. and King, M.C. (2008). *Understanding the social dimension of sustainability*, Routledge, New York.

Eikhof, D. R., Warhurst, C., and Haunschild, A. (2007) Introduction: What work? What life? What balance? Critical reflections on the work-life balance debate. *Employee Relations*. 29(4), 325–333.

Elkington, J. (1998) Partnerships from cannibals with forks: the triple bottom line of 21st-century business. *Environmental Quality Management*. 8, pp. 37-51.

Elmualim, A., Czwakiel, A., Valle, R., Ludlow, G. and Shah, S. (2008) Barriers for implementing sustainable facilities management. In *World Sustainable Building Conference September 2008, Melbourne, Australia*, edited: CSIRO, Australia.

European Council (2001) Presidency Conclusions, Göteborg European Council, European Council.

Empacher, C., Wehling, P. (1999) Indikatoren sozialer Nachhaltigkeit, ISOE Diskussionspapiere 13.

Fapohunda T. M. (2014) An exploration of the effects of work life balance on productivity. *Journal of Human Resources Management and Labor Studies* [online June 2016]. 2(2), pp.71-89.

Fischer-Kowalski, M. and Haberl, H. (1993) Metabolism and colonisation: modes of production and the physical exchange between societies and nature. *Innovation in Social Science Research*. 6, pp.415-442.

Fisher, J. A., and Monahan, T. (2008) Tracking the social dimensions of RFID systems in hospitals. *Int J Med Inform,* 77(3), 176-183. doi:10.1016/j.ijmedinf.2007.04.010

Frone, M. R. (2003). Work-family balance. In J. C. Quick and L. E. Tetrick (Eds.), Handbook of occupational health psychology. pp. 143–162. Washington, DC: American Psychological Association.

Galinsky, E., Bond, J.T., and Hill, E.J. (2004) When work works: A status report on workplace flexibility: Who has it? Who wants it? What difference does it make? Retrieved on 16/03/2017 from http://familiesandwork.org/3w/research/downloads/status.pdf

Grimshaw, B. (2007) History is bunk: Considerations on the future of FM. *Facilities, 25*(11/12), pp. 411-417.

Grimshaw, R.W. (2005). Mobility: indicators of performance. *Knowledge paper*, JCI, London.

 International Facilities Management Association (IFMA) (2014). Sustainable facility management: the integration of sustainability into a facility manager’s core competencies. Accessed from http://www.feapc.com/ on 16/05/2016.

Hing Lo, S., van Breukelen, G. J. P., Peters, G. J. Y., and Kok, G. (2014) Teleconference use among ofﬁce workers: An interorganizational comparison of an extended theory of planned behavior model. *Administrative Sciences, 4*(1), 51-70.

Hodges, C. P. (2005) A facility manager's approach to sustainability. *Journal of Facilities Management*, 3(4), pp. 312-324.

Hodge, R. A. and Hardi, P. (1997) The Need for Guidelines: The Rationale Underlying the Bellagio Principles for Assessment’, in P. Hardi and T. Zdan (Editors.) Assessing Sustainable Development. Principles in Practice, International Institute for Sustainable Development, Winnipeg, Manitoba, pp. 7-20

Hoeven, C. L. T., van Zoonen, W., Fonner, K. L. (2016). The practical paradox of technology: The influence of communication technology use on employee burnout and engagement. *Communication Monograph 83*(2), 239-263.

Huselid, M. A. and Becker, B. E. (1996) Methodological issues in cross-sectional and panel estimates of the human resource – firm performance link, Industrial Relations, 35, 400–22.

Jensen, P.A., Sarasoja, A.L., Van der Voordt, T. and Coenen, C. (2013) How can facilities management add value to organisations as well as to society? Conference paper. Brisbane, Australia: CIB World Building Congress, 5-9 May 2013.

Jiang, H. (2016) The impact of communication technologies on employees' well-being. Available from: <http://www.instituteforpr.org/impact-communication-technologies-employees-well/> [Accessed 2/04/2017.

Kandampully, J., Bilgihan, A., and Zhang, T. (2016) Developing a people-technology hybrids model to unleash innovation and creativity: The new hospitality frontier. *Journal of Hospitality and Tourism Management,* 29, 154-164. doi:10.1016/j.jhtm.2016.07.03

Kasim, R., and Hudson, J. (2006). FM as a social enterprise. *Facilities*, 24(7/8), pp.292-299.

Kurland, N. B., and Cooper, C. D. (2002). Manager control and employee isolation in telecommuting environments. *Journal of High Technology Management Research*, 13, pp.107-126.

Kopfmüller, J., Brandl, V., Sardemann, G., Coenen, R., and Jörissen, J. (2000), Vorläufige Liste der Indikatoren für das HGF-Verbundprojekt, HGF Project Working Papers, Karlsruhe.

Lindkvist, C. and Elmualim, A. (2009) Pervasive technologies for workspace management. *Journal of Facilities Management,* 7**,** pp.98-110.

Lance, C. E. (1991) Evaluation of a structural model relating job satisfaction, organizational commitment and precursors to voluntary turnover. *Multivariate Behav Res*. 26, pp.137–162.

Lai, J.H.K. and F.W.H. Yik. (2006) Knowledge and perception of operation and maintenance practitioners in Hong Kong about sustainable buildings. *Facilities* 24 (3/4) pp.90-105.

Littig, B., and Grießler, E. (2005) Social sustainability: a catchword between political pragmatism and social theory. *International journal of sustainable development*, *8*(1-2), pp.65-79.

Martin, L., and Omrani, N. (2015). An assessment of trends in technology use, innovative work practices and employees’ attitudes in Europe. *Applied Economics,* 47(6), pp.623-638.

Marshall, G. W., Michaels, C. E., and Mulki, J. P. (2007) Workplace isolation: Exploring the construct and its measurement. *Psychology and Marketing,* 24(3), pp.195-223. <http://dx.doi.org/10.1002/mar.20158>

Mokyr, J., Vickers, C. and Zieberth, N. L. (2015) The History of Technological Anxiety and the Future of Economic Growth: Is This Time Different? *Journal of Economic Perspectives,* 29**,** pp. 31-50.

Nam, T. (2014) Technology Use and Work-Life Balance. *Applied Research Quality Life*. 9, pp.1017–1040

Nicholas, A. J., and Guzman, I. R. (2009) Is Teleworking for the Millennials? Paper presented at the SIGMISCPR 2009, May 28–30

Nicholas J. Beutell, (2010) Work schedule, work schedule control and satisfaction in relation to work-family conflict, work-family synergy, and domain satisfaction. *Career Development International,* 15(5) pp.501 – 518

Nutt, B. (1999) Linking FM practice and research. *Facilities*, 17 (1/2), pp. 11-17.

Nutt, B. (2000) Four competing futures for facility management. *Facilities*, 18 (3/4), pp.124-32.

Osterman, P. (2006) Wage effects of high performance work organization in manufacturing, *Industrial and Labor Relations Review*, 59, pp.187–204.

Osin, E, (2009) Subjective Experience of Alienation: Measurement and Correlates. EMPIRISCHE FORSCHUNG

Pathirage, C., Haigh, R., Amaratunga, D., and Baldry, D. (2008) Knowledge management practices in facilities organisations: a case study. *Journal of Facilities Management*, 6(1), pp.5-22.

Pitt, M. (2005) Innovation in strategic supplier contract management. Property Executive, January 2005

Sarpin, N. (2015). *Developing people capabilities for the promotion of sustainability in facilitiy management practices* Ph.D., Queensland University of Technology.

Senghaas-Knobloch, E. (1998) Von der Arbeits- zur Tätigkeitsgesellschaft? Politikoptionen und Kriterien zur ihrer Abschätzung’ Feministische Studien, Vol. 16(2), pp. 9-30.

Shah, S. (2007) *Sustainable Practice for the Facilities Manager.* Blackwell Publishing, Oxford.

Taival, D. (2017). Emerging tools and technologies for high-performance buildings. Retrieved 10/04/2017, from FMLink Group file:///C:/Users/JONATHAN/Desktop/Unekwu/Technological%20innovations%20from%202000%202017/Emerging%20Tools%20and%20Technologies%20for%20High-Performance%20Buildings%20-%20FMLink.html

Tajfel, H., and Turner, J. (1986) The social identity theory of intergroup behavior. In S. Worchel & W. Austin (Eds.), Psychology of Intergroup Relations (pp. 7–24). Chicago: Nelson.

Thompson, C. A., Beauvais, L. L., and Lyness, K. S. (1999) When work-family benefits are not enough: the influence of work-family culture on benefit utilization, organizational attachment, and work-family conflict. *Journal of Vocational Behavior,* 54(3), pp.392–415.

 Division for Sustainable Development. Department of Policy Co-ordination and Sustainable Development (UNDPCSD UN) (1995) Work Programme on Indicators of Sustainable Development, Document UN/E/CN.17/1995/18. United Nations, New York.

United Nations (UN) (1992) Agenda 21, New York.

United Nations (Ed.) (1993) Earth Summit: Agenda 21, the United Nations programme of action from Rio, United Nations, New York.

van der Merwe C. (2010) Facilities managers vital in achieving green building targets [http://www.engineeringnews.co.za/article/facility-managers-vital-in-achieving-green-building targets. accessed](http://www.engineeringnews.co.za/article/facility-managers-vital-in-achieving-green-building%20targets.%20%09accessed) 30/03/17

van Saane, N. J. K. Sluiter, J. H. A. M. Verbeek and M. H. W. Frings-Dresen (2003) Reliability and validity of instruments measuring job satisfaction—a systematic review. Occupational Medicine 2003;53:191–200

Van Reenen, J. (2011) Does competition raise productivity through improving management quality?, *International Journal of Industrial Organization.* 29, pp.306–16.

Vallance, S., Perkins, H. C. and Dixon, J. E. (2011). What is social sustainability? A clarification of concepts. *Geoforum,* 42(3).

Valtorta, N. K., Kanaan, M., Gilbody, S., and Hanratty, B. (2016) Loneliness, social isolation and social relationships: what are we measuring? A novel framework for classifying and comparing tools. *BMJ open*, 6(4).

Vanclay, F. (2004) Impact Assessment and the Triple Bottom Line - Competing Pathways to Sustainability? Sustainability and Social Science: Round Table Proceedings. H. Cheney, E. Katz and F. Solomon. Melbourne, Institute for Sustainable Futures, Sydney and CSIRO Minerals, Melbourne: 27-39.

Wackernagel, M. and Rees, W. E. (1995) *Our Ecolocigal Footprint, Reducing Human Impact on Earth*. New Society Publication, Gabriola Island.

Wackernagel, M. (2001) Shortcomings of the Environmental Sustainability Index. http://www.anti-lomborg.com/ESI%20critique.rtf (download 01.31.2017).

Ware, J. and Grantham, C. (2003) The future of work: Changing patterns of workforce management and their impact on the workplace. *Journal of facilities management*. 2(2), pp.142 – 159.

Wajcman, J., Bittman, M., and Brown, J. (2008). Families without borders: Mobile phones, connectedness and work-home divisions. *Sociology*. 40(4), pp.635–652.

Wallace, P. (2004). The Internet in the workplace: How new technology is transforming work. New York: Cambridge University Press

West, D. M. (2015). What happens if robots take the jobs? The impact of technologies on employment and public policy.

White, M. and Bryson, A. (2013) Positive employee attitudes: how much human resource management do you need?, *Human Relations*, 66, 385–406. doi:10.1177/0018726712465096

Wiewiora, A., Trigunarsyah, B. and Murphy, G. (2010) Knowledge transfer in project based organisation Rethinking Sustainable Development: Urban Management, Engineering, and Design

World Commission on Environment and Development, WCED (1987) Our Common Future, Oxford University Press, Oxford

Wolbring, G. and Rybchinski, T. (2013) Social sustainability and its indicators through a disability studies and an ability studies lens. *Sustainability*, *5*(11), 4889-4907.

Zavaleta, D., Samuel, K., and Mills, C. (2014) *Social isolation: A conceptual and measurement proposal* (No. ophiwp067). Queen Elizabeth House, University of Oxford.

Zhang, J. (2016) The dark side of virtual office and job satisfaction. *International journal of business and management.* 11(2).