Are the ageing workforce satisfied with the construction work environment?

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Abstract

The construction industry is experiencing shortage of workforce and skill gap due to the significant reduction in younger workforce entering the construction industry compared to the exponential number of retiring workers. The proposed solution to this dilemma is to encourage retiring (older) workers to forgo retirement and stay in the construction industry longer. Providing ageing workforce with a satisfactory construction work environment (CWE) can be one of the ways to encourage them to remain in the construction industry. Therefore, the present study aims to assess the level of satisfaction of ageing workforce with the CWE. The study adopted a quantitative approach and data was sourced from older construction workforce in Edinburgh, Scotland using questionnaire survey. Factor analysis and mean score analysis were employed to assess the older workers level of satisfaction with the CWE. The study identified five principal components of the CWE termed as organizational-psychological environment, physical environment, functional environment, policies and practices environment and auxiliary environment. The older workers were most satisfied with the functional environment, followed by the auxiliary environment, policies and practices environment, physical environment and lastly, organizational-psychological environment. The study recommended that the construction industry to put in more effort in making the CWE very satisfying to all workers especially the ageing workforce. A very satisfying CWE should compensated and amend the losses accompanying ageing. The authors encourage future studies to explore the relationship between the level of satisfaction with the CWE and the quality of life (QOL) of the ageing workforce.

Keywords: Ageing, Older workforce, Construction work environment, Construction industry

Introduction

The twenty-first century is experiencing an unprecedented birth of an ageing population. The decrease in fertility and increase in life expectancy has caused an increase in certain age group; older people live longer due to the continuous improvement in the health care and health awareness

(United Nations, 2017). The growing trend of the population ageing has reflected in global, regional and national statistical data. The global population is ageing; population aged 60 or above is growing faster than all other younger age groups. In 2017, 13 per cent of the global population aged 60 or above representing 962 million people. It is projected that the 60 or above age group will increase to 1.4 billion in 2030 and 2.1 billion (representing 56 per cent) in 2050 (United Nations, 2017).

Population ageing has been one of the most significant social transformers of the twenty-first century with implications on virtually all sectors of the society, including the labour and financial markets, demand for goods and services and family structures (United Nations, 2015). The labour market will experience shortage of workforce and skill gap in the next few years because the number of young people entering the workforce will significantly reduce compared to the number of people retiring (McNair and Flynn, 2006). The proposed solution to this dilemma is to make better or more flexible use of older workers and encourage them to stay in work longer (McNair and Flynn, 2006).

Interestingly, the population of older workforce that forego retirement is increasing exponentially due to changes in retirement policies (Choi, 2015). The trend of the aged remaining in the workforce has the potential to improve a nation's economy. The United Nations described the ageing population as a contributor to development (United Nations, 2017). Consequently, companies support the initiative of retaining their older employees due to the valuable knowledge and experience they possess (Choi, 2015; Leaviss *et al*., 2008). This implies that within the next few years the current workplaces need to be re-designed not just to accommodate the ageing workforce but also to improve their quality of life (QOL), so they can age healthy and remain in the workforce for as long as possible. Therefore, the present study aims to assess the level of satisfaction of ageing workforce with the construction work environment.

Population ageing and the construction industry

Population ageing has been one of the most significant social transformers of the twenty-first century with implications on virtually all sectors of the society, including the labour and financial markets, demand for goods and services and family structures (United Nations, 2015). Ageing is mostly pictured as retirement as retirement age for most countries are set at 65 (Molenbroek, Mantas and Bruin, 2011). The implication is that the labour market will experience shortage of workforce and skill gap in the next few years because the number of younger people entering the workforce will significantly reduce compared to the number of people retiring (McNair and Flynn, 2006). Industries that offer service to the elderly population are projected to have the most significant shortage of labour – typically, the Healthcare, Personal Care/Services and Community Social Service (Gonzales, 2013). The direct implication of this phenomenon will reflect in a poor performance of the global economy. The obvious solution to this is to extend the retirement age. This initiative is being implemented in the United Kingdom (UK) where the stage pension age is being increased to 66 in 2020 and an official retirement age has been abolished (Age UK, 2018; Department for Work and Pensions, 2017).

The change in age structure of the population does not only mean new socio-political policies and responsibilities, but also new designs of all kinds of equipment, technical aids, plans for flats or homes for older persons (Dayé and Austria, 2011). The ageing population is creating growing demand for products and services that improves QOL and independent living (Coughlin, 2014). Suppliers of these products and services perceive the growing change in demand as new business opportunities. Companies including Toyota, Intel and pharmaceuticals perceive the ageing population as an opportunity and determinants of their future strategies (Coughlin, 2014). Ageing also has an impact on the ageing individual. The ageing population are mostly prone to multiply and increasing physical impairments such as vision, hearing, strength, balance, and response time (Barlow and Venables, 2004; Gann, Barlow and Venables, 1999). Consequently, increasing the pressure on health care systems as demand for services rises.

The construction industry must also adapt to the changing demand of the aged. The construction industry will experience increasing pressure to redesigned existing homes and wider surroundings and to construct new homes and surroundings to meet the increasing demand (CIOB, 2015). The main challenge is, will the construction industry meet the increasing demand? Proposed initiatives such as increasing the retirement age may not offer the needed solutions to the construction industry. The reason being that the construction industry involves tough, heavy and physically demanding work (Schwatka, Butler and Rosecrance, 2011; Eaves *et al*., 2016). The construction industry is unfavourable for workers of all ages, however this environment can only catalyse the deteriorating ageing changes of ageing workforce (Eaves *et al*., 2016). The capability of workforce to carry out heavy manual work declines between the ages of 40-50 due to the reduced physical capabilities such as strength, balance, and processing speed (Ilmarinen and Rantanen, 1999; Schwatka, Butler and Rosecrance, 2011). Consequently, this limit the older workforce to the type of work they can perform; furthermore, it can affect their general health, wellbeing and QOL (Eaves *et al*., 2016).

The construction work environment (CWE)

In general, the environment has been internationally agreed as one of the important domains of QOL (WHO, 1996). In other words, the quality of work life is a domain of overall QOL that is influenced by work (Varghese and Jayan 2013). Since the 1970s, quality of work life as a domain of QOL has been studied independently (Lawler, 1982; Hackman and Suttle 1977; Davis and Cherns 1975).

The CWE is one of the most hazardous in almost every country. The picture painted is always a poor work environment. The nature of work in the CWE is described as tough, heavy and physically demanding (Schwatka, Butler and Rosecrance, 2011; Eaves *et al*., 2016). The CWE is unfavourable for workers of all ages, however this environment can only catalyse the deteriorating ageing changes of ageing workforce (Eaves *et al*., 2016). How can the construction industry accommodate the ageing workforce and continue to maintain a high productive environment? The proposed solution to this dilemma is to properly evaluate and modify the CWE to complement the needs of the ageing workforce (Leaviss *et al*., 2008).

As increasing older construction workforce forgo retirement and spend most of their time on construction site they will need to depend on the environment on construction sites to overcome or compensate for the multiply and increasing physical impairments such as vision, hearing, strength, balance, and response time (van Hoof *et al*., 2009; Barlow and Venables, 2004; Gann, Barlow and Venables, 1999). Environmental psychology researchers have devoted attention and resources on researching about the influences of the built and natural environments on the health, comfort, safety, behaviour and attitudes of occupants (Vischer and Wifi, 2017). According to environmental psychologist, QOL largely depends on understanding the needs of the older workforce. The degree to which the older workforce needs are met determines their QOL (Vischer and Wifi, 2017). This means that providing a healthy and comfortable CWE is fundamental to promoting and maintaining the QOL of not only the older workforce but also the younger workforce. The academic community has extensively explored with proven evidence that healthy and comfortable CWE can be therapeutic (Wong *et al.*, 2014; Day, Carreon and Stump, 2000; Bakker, 2003).

The person-environment (P-E) fit theory further clarify the need for a fit between the ageing workforce and the CWE. Amongst several P-E fit models that have been proposed to address the P-E interaction and the importance of matching the demands of the environment with the competences of older individuals are the needs-supplies fit and the demands-abilities fit model (Lewin, 1951; Wister, 1989; Lawton and Nahemow, 1973; Kahana, 1982, Carp and Carp, 1984; Kristof, 1996; French, Rodgers and Cobb, 1974). According to the needs-supplies model, fit is attained when the CWE provides the older workforce's preferred suppliers (supplies are the desired needs, resources, values or preferences) and opportunity to satisfy their needs (such as the need to use skills and abilities). On the contrary, there is a mismatch when the CWE provides too little or too much of the preferred suppliers (Kristof, 1996; Kahana, 1982, Carp and Carp, 1984; Kristof, 1996; French, Rodgers and Cobb, 1974). According to the demands-abilities model, fit is achieved when the demands of the CWE (such as job demands) matches with the abilities and skills of the older workforce, otherwise there is a mismatch (Lawton and Nahemow, 1973; French, Rodgers and Cobb, 1974; Danford and Steinfeld, 1999).

In other words, there is a fit when the CWE compensates for older workforce's characteristics (multiply and increasing physical impairments such as vision, hearing, strength, balance, and response time) while there is a mismatch when the CWE provides too much or too little compensation. Since the ageing workforce are now spending more time working, accommodating work place environments can help modify rates of potential impairment by meeting and supporting declining health needs, perhaps more than current medical and social interventions alone (Cohen, Scribner and Farley, 2000; Iwarsson, 2005). P-E theory assumes that a match between the older workforce and the CWE leads to reduced stress, increased satisfaction, performance, well-being and improved QOL whereas a mismatch leads to opposite outcomes (Iwarsson, Horstmann and Slaug, 2007; Edwards and Shipp, 2007; Oswald *et al*., 2007; Lien, 2013; Wahl, Iwarsson, and Oswald, 2012).

Construction work environment (CWE) facets

In relations to this study, the CWE facets are the approaches, support services, adjustments, practices, policies and/or procedures that organisations implement which can positively or negatively impact the health, safety, comfort, productivity and QOL of older workforce (adopted from Choi, 2015; Vischer, 1989). The rational is to improve P-E fit by identifying facets in the CWE that affects fit between the older workforce and the CWE.

Two main projects (Leaviss *et al*., 2008 and Buckle *et al*., 2008) funded by Strategic Promotion of Ageing Research Capacity (SPARC) explored the older workers and their workplace. Leaviss *et al*. (2008) focused on understanding the older worker and the work environment in the construction industry. In-depth semi-structured interviews and focus groups were employed to understand the older workers in the construction industry. Upon critical review of the findings of Leaviss *et al*. (2008), eighteen (18) CWE facets were identified. These facets were supplemented and confirmed by findings of Buckle *et al*. (2008), Eaves *et al*. (2016), Eaves *et al*. (2015), Vischer (2007), Bell (2015), Boschman *et al*. (2013), Aulin *et al*. (2009), Lynch *et al*. (2000), Portero and Oliva (2007) and Takim, Talib and Nawawi (2016). These facets are listed in Table 1.

Workforce in the construction industry are either employed directly or indirectly (Leaviss *et al*., 2008). Indirectly employed workforce are subcontracted with most of the workers being self-employed while employers bear the risk for employing workforce directly. Directly employed older workforce are perceived to be engaged in less physical demanding tasks. It is perceived that being indirectly employed has negative effects on older workforce (Leaviss *et al*., 2008; Buckle *et al*., 2008; Bell, 2015). The construction industry is known for its long working hours, however as workforce age they would prefer flexible employment option such as working from home, part-time and convenient shift pattern (Leaviss *et al*., 2008; Buckle *et al*., 2008). The construction industry is very competitive, and most contracts are won based on price and time for completion. Consequently, determining the payment structure which gives financial reward for speed–more attractive to younger and physically fit workforce (Leaviss *et al*., 2008). Payment structure based on day rate is more favourable for older workforce than piecework-based payment structure. It was also acknowledged that piecework payment structure can hinder quality of work (Leaviss *et al*., 2008). Salary inequality and discrimination treatment affects CWE (Lynch *et al*., 2000; Takim, Talib and Nawawi, 2016). The construction industry is dominated with repetitive tasks, manual handling of heavy materials, and wet works. Older workforce engaged in repetitive tasks such as hammering can lead to worsen joint problems and manual heavy tasks such a bricklaying can result in musculoskeletal disorders (MSDs) and wet tasks such as plastering can lead to rheumatic problems (Leaviss *et al*., 2008). Alternative methods such as nail guns instead of hammer can make repetitive tasks less demanding and the same applies to manual handling aide, lifting devices and alternative materials and methods to reduce wet task such as drylining (Leaviss *et al*., 2008; Eaves *et al*., 2016).

< Insert Table 1 about here >

Adopting task allocation approaches such as job rotation, job sharing and engaging older workforce in more skilled, but less physically demanding task such as training, health and safety roles can ease work load on older workforce (Leaviss *et al*., 2008; Buckle *et al*., 2008; Eaves *et al*., 2016). Personal protective equipment (PPE), tools and equipment used by older workforce can also impact on the demanding nature of tasks. Furthermore, the degree of environmental control (such as empowerment) older workforce have through decision-making processes can also impact the QOL in the construction industry (Vischer, 2007).

Research methodology

Sampling and data collection

Using convenience sampling technique, the researcher first contacted eleven (11) ongoing construction projects in Edinburgh, Scotland to participate in the study. However, only five of these projects agreed to participate in the study. Furthermore, purposive sampling technique was used to select older workers amongst all worker in the five construction projects that agreed to participate in the study. Older workers refer to participants who were aged 40 years and above (see Leaviss *et al*., 2008 and Buckle *et al*., 2008).

A total of 100 questionnaires were administered to older workforce and 38 completed questionnaires were retrieved, representing a response rate of 38 per cent. Albeit the sample size was relatively small, statistical analysis could still be performed because according to the generally accepted rule, with a sample size of 30 or above, the central limit theorem holds true (Ott and Longnecker, 2010). Furthermore, Kane (2003) recommended that a sample of 20 or more older residents out of 100 older residents is sufficient for QOL research.

100 per cent of the respondents were older workers according to the definition of the study. The survey results further indicated that 89.4 per cent of the respondents have been working in the construction industry for more than 10 years. The participants in the study occupy several roles in the construction industry. These included project managers, site managers, clerk of woks, health and safety managers, quantity surveyors, contractors, bricklayers, carpenters, electricians, mechanical engineers, labourer, and plumbers.

Questionnaire development

The study defined CWE facets as the approaches, support services, adjustments, practices, policies and/or procedures that organisations implement which can positively or negatively impact the health, safety, comfort, productivity and QOL of older workforce (adopted from Choi, 2015; Vischer, 1989). Eighteen (18) construction work facets were identified from Leaviss *et al*. (2008), Buckle *et al*. (2008), Eaves *et al*. (2016), Eaves *et al*. (2015), Vischer (2007), Bell (2015), Boschman *et al*. (2013), Aulin *et al*. (2009), Lynch *et al*. (2000), Portero and Oliva (2007) and Takim, Talib and Nawawi (2016) as shown in Table 2. The level of satisfaction was measured with a five-point Likert scale ranging from 1 (very dissatisfied) to 5 (very satisfied). The data was analysed using factor analysis and mean score analysis.

Data analysis

Due to the large number of variables (18 facets), factor analysis was used to identify facets that measure the same underlying construct. Factor analysis is a statistical approach that reduce large quantity of variables into a more easily understood component with a minimum loss of information (Field, 2005; Ahadzie, 2007).

< Insert Table 2 about here >

Results

Reliability analysis

Prior to the analysis, Cronbach's reliability test was used to examine the internal consistency of the dataset of the 18 facets. The overall Cronbach alpha value of the 18 facets as shown in Table 3 is 0.853 which is greater than 0.7. This implies that there is a good internal consistency and reliability with the dataset and the five-point Likert scale adopted for the study (Field, 2005). Furthermore, Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity was conducted to test the appropriateness of using factor analysis and the degree of inter-correlation amongst the facets respectively (Field, 2005). Field (2005) and Child (1990) recommended a KMO value not less than 0.5. A KMO value below 0.5 implies a large correlation amongst the facets hence inappropriate for factor analysis (Field, 2005; Child, 1990). The KMO value for the 18 facets as shown in Table 3 is 0.616 which is greater than 0.5, confirming that factor analysis is appropriate for the study. From Table 3, the Bartlett's Test of Sphericity is relatively large (=432.516) and the significance is small (p-value = 0.000) which implies that the correlation matrix is not an identity matrix (see Table 4) (Ameyaw, 2015).

< Insert Table 3 about here >

< Insert Table 4 about here >

Factor analysis

The facets were further subject to principal component analysis with varimax rotation. Table 5 shows the communalities of the facets after extraction. The communalities show how much of the variance in the facets has been accounted for by the extracted facets and is very useful in deciding which facets to be factor analysed. From Table 5, all the variables have extraction value more than 0.5, thus adequate for factor analysis (Kim and Mueller, 1978).

< Insert Table 5 about here >

The number of components to be extracted were determined using both Guttman-Kaiser rule and the Cattell scree test. Guttman-Kaiser rule suggests that factors with eigenvalue greater than 1 should be retained. Also, the Cattell scree test suggests that all further components after the one starting the elbow should not be retained. Therefore, five components with eigenvalue greater than 1.00 were extracted with varimax rotation after 6 iterations, explaining 74.010 per cent (see Table 6) of the total variance. The scree plot (Figure 1) further confirm the five components. The rotated component matrix of the principal component is presented in Table 7. The relationship between the facets in each of the five principal components led to the following interpretation; component 1 is termed organizational-psychological environment; component 2, physical environment; component 3, functional environment; component 4, policies and practices environment; component 5, auxiliary environment.

< Insert Table 6 about here >

< Insert Figure 1 about here >

< Insert Table 7 about here >

Mean score analysis

The level of satisfaction with each of the 5 components is derived using mean score analysis as shown in Table 8. The facet with the highest mean score was ranked highest and the facet with the lowest mean score was ranked lowest. In cases where two or more facets have the same mean score, the one with the lowest standard deviation was assigned the highest ranking (Field, 2005; Ahadzie, 2007).

< Insert Table 8 about here >

Discussion

Component 1: Organisational-psychological environment

Component 1 explained 24.52 per cent of the total variance. The CWE facets which loaded onto this component were *payment structure, career opportunities/advancement, salary, management plan and style, attitudes of management, job security/employment tenure, environmental control and shift-work patterns*. These 8 facets were collectively termed as the organisational-psychological environment of the construction industry. The organisational-psychological environment has the potential to positively or negatively affect the mental well-being of older workforce. A dissatisfaction in these factors can lead to constant mental stress for older workforce (Boschman *et al*., 2013). Although the organizational-psychological environment had an overall mean of 3.60, a standard deviation of 0.835 and standard error of 0.135, it was ranked as the least satisfactory in the construction industry.

The level of satisfaction falls in between ‘neither satisfied nor dissatisfied’ and ‘satisfied’ according to the level of satisfaction scale adopted. The older workers were not very satisfied with their payment structure, salary, job security/employment tenure and career opportunities/advancement plausible because the construction industry is very competitive, and most contracts are won based on price and time for completion. Consequently, determining the salary and payment structure which gives financial reward for speed. This environment that rewards speed is unfavourable for older workers who are experiencing increasing physical impairments which affects their speed. Obviously, the older worker would perceive this as discrimination and threat to their job security and career advancement in the construction industry. As argued by Leaviss *et al*. (2008), Lynch *et al*. (2000) and Takim, Talib and Nawawi (2016) salary inequality and discrimination treatment affects CWE. Furthermore, the older workers were somewhat not very satisfied with their management plan and style, attitudes of management, environmental control and shift-work pattern. The temporary nature of construction projects resulting in different management on different project can inhibit management-worker relationship. Different projects come with different management plan, style and attitude towards the older worker. A mismatch between the environment created by different management and the older workers preferences can cause psychological stress which affect job performance, health, well-being and QOL (Buckle *et al*., 2008; Bell, 2015; Vischer, 2007). Furthermore, the degree of environmental choice or empowerment older workforce feel they have through decision-making processes can also impact the QOL in the construction industry (Vischer, 2007).

Component 2: Physical environment

Component 2 explained 18.14 per cent of the total variance. The CWE facets which loaded onto this component were *performing repetitive tasks, manual handling of heavy materials, performing wet task, and task allocation/schedule approach*. The 4 facets were collectively termed as the physical environment of the construction industry. The physical environment deals with how tasks are performed within the construction industry. With an overall mean of 3.72, standard deviation of 0.838 and standard error of 0.136, the physical environment was ranked fourth amongst the five components. The level of satisfaction falls in between ‘neither satisfied nor dissatisfied’ and ‘satisfied’ according to the level of satisfaction scale adopted.

The construction industry is dominated with repetitive tasks, manual handling of heavy materials, and wet works. Older workforce engaged in repetitive tasks such as hammering can lead to worsen joint problems and manual heavy tasks such a bricklaying can result in MSDs and wet tasks such as plastering can lead to rheumatic problems (Leaviss *et al*., 2008). Since the older workers are not very satisfied with the physical environment, it can be inferred that the physical environment is currently catalysing the deteriorating aging changes of the older workers. This calls for alternative measures such as nail guns instead of hammer can make repetitive tasks less demanding and the same applies to manual handling aide, lifting devices and alternative materials and methods to reduce wet task such as drylining (Leaviss *et al*., 2008; Eaves *et al*., 2016).

Closely linked to this is how tasks are allocated in the construction. Adopting task allocation approaches such as job rotation and job sharing where older workers perform tasks with younger and more energetic workforce can increase the older workers physical environment satisfaction level (Leaviss *et al*., 2008; Buckle *et al*., 2008; Eaves *et al*., 2016).

Component 3: Functional environment

Component 3 explained 10.81 per cent of the total variance. The CWE facet that loaded on this component was *engagement in more skilled, but less physically demanding task*. Subsequently, this component was termed functional environment. Functional environment deals with engaging the older workers in construction work related task and activities where their functional competence overcome or match with the environment. The functional environment was ranked first amongst the five components with a mean score of 4.08, standard deviation of 0.673 and standard error of 0.109. The level of satisfaction falls in between 'satisfied' and 'very satisfied' according to the level of satisfaction scale adopted.

The nature of work in the CWE is described as tough, heavy and physically demanding (Schwatka, Butler and Rosecrance, 2011; Eaves *et al*., 2016). Engaging older workforce in unskilled tasks which are more physically demanding will only catalyse the deteriorating ageing changes of ageing workforce (Eaves *et al*., 2016). Interestingly, most of the older workers that participated in the study were engaged in skilled works that are less physically demanding. For example, all the 60 and over aged group that participated in the study were health and safety managers or site managers. Therefore, it is not surprising that the older workforce perceived and ranked their functional environment as the most satisfactory amongst others. This is plausible because their functional competence increases when they are engaged in more skilled tasks.

Component 4: Policies and practices environment

Component 4 explained 10.39 per cent of the total variance. The CWE facet that loaded on this component were *personal protective equipment (PPE), protection from environmental exposures such as heat, dust, noise and weather and employment flexibility*. The 3 facets were collectively termed as the policy and practice environment of the construction industry. With a mean score of 3.78, standard deviation of 0.778 and standard error of 0.126, policies and practices environment was ranked third among five factors. The level of satisfaction falls in between 'neither satisfied nor dissatisfied' and 'satisfied' according to the level of satisfaction scale adopted.

This environment deals with the policies and practices that are implemented to protect the older workforce from exposure to construction work place hazards and risk of injury. According to the

Egan (1998) the health and safety record in the construction industry is the second worst of any industry. The older workforce seems to be somewhat satisfied with current policies such as health and safety policy and PPE policy. However, the older workforce will be more satisfied if these policies are modified to focus more on older workforce and adequately put into practice.

Component 5: Auxiliary environment

Component 5 explained 10.15 per cent of the total variance. The CWE facet that loaded on this component were *tools and equipment and social networks in the workplace*. The 2 facets were collectively termed as the auxiliary environment of the construction industry. Auxiliary environment deals with supplementary support and measures used to sustain and boost the performance of the older workforce. The auxiliary environment is the second most satisfied environment in the construction industry with a mean of 3.84, standard deviation of 0.648 and standard error of 0.105. The level of satisfaction falls in between ‘neither satisfied nor dissatisfied’ and ‘satisfied’ according to the level of satisfaction scale adopted.

Tools and equipment to some extent can minimise the demanding nature of task in the construction industry. However, tools and equipment that are not purposively designed for older worker can be a hinderance to the functioning of the older workers. Also, a good auxiliary environment should provide opportunity for its members to interact and socialise. Social interaction with other people is a source of emotional support, companionship, instrumental help, and advice (Portero and Oliva, 2007). The degree of loneliness and isolation experience by older workforce somewhat depends on the interaction opportunities created by the auxiliary environment (Portero and Oliva, 2007).

Contribution to knowledge

The birth of an ageing population has been one of the most significant social transformers in the twenty-first century with implication on all sectors including the construction industry. Consequently, there has been advances in knowledge on elders living in built facilities, however research about the older workforce that played key roles in building these facilities is still in its infancy. This study succeeded in extending the frontier of knowledge with cutting-edge findings on the facets of the CWE specially focusing on the older workforce.

First, the study has identified 18 facets of the CWE from previous research. The notable added knowledge is grouping these facets into well-defined five principal components. These five components explained 74.01 per cent of the total variance. The study identified that the organisational-psychological environment (Component 1) has the potential to positively or negatively affect the mental well-being of older workforce. The physical environment (Component 2) deals with how tasks are performed within the construction industry. Functional environment (Component 3) deals with engaging the older workers in construction work related task and activities where their functional competence overcome or match with the environment. The policies and practices environment (Component 4) deals with the policies and practices that are implemented to protect the older workforce from exposure to construction work place hazards and risk of injury. Finally, the auxiliary environment (Component 5) deals with supplementary support and measures used to sustain and boost the performance of the older workforce. The study further contributed to the body of knowledge by identifying that the older workers were more satisfied with the functional environment followed by the auxiliary environment, policies and practices environment, physical environment and lastly, organizational-psychological environment.

Limitations of the research

Readers, management and decision-makers in the construction industry should be aware that the findings of this cross-sectional study are constrained by limited sample size of older workforce and the possibility of common method bias due to the self-report survey instrument adopted. However, this should not invalidate the findings and conclusions of the study because reliable measures were taken to mitigate the likelihood of this bias. Firstly, all the older workers were purposively selected across 5 different ongoing construction projects and were aged 40 years and above at the time of the survey. Secondly, 89 per cent the older workers have been working in the construction industry for more than 10 years, meaning that they had in-depth knowledge about the CWE facets. Thirdly, Cronbach's reliability test also confirmed the reliability of the measuring scale adopted for the study.

Recommendations

Practical Implication

Providing ageing workforce with a satisfactory CWE can be one of the ways to encourage them to remain in the construction industry. Although the findings of this study revealed that the older workers are satisfied with the CWE facets, the construction industry need to put in more effort in making the CWE very satisfying to all workers especially the ageing workforce. A very satisfying CWE should compensated and amend the losses accompanying ageing. Critical attention should be given to the following least satisfying CWE facets identified in the study. These facets include, shift-work patterns, environmental control, job security, task allocation schedule, performing wet task, employment flexibility, and opportunity to socialise. These facets should be amended to reinforce recovery, adaptation and psychological growth amongst the ageing workforce. For example, the shift-work patterns should be flexible and convenient for older workers to follow. The older workers should be given more control of their environment and empowered to make decisions. More importantly, the construction industry should take into consideration the physical slowness of older workers. An environment that rewards speed is unfavourable for older workers and the older workers might perceive this as discrimination and treat to their job security. As suggested by other researchers (Leaviss *et al*., 2008; Buckle *et al*., 2008; Eaves *et al*., 2016), the study also recommend task allocation approaches such as job sharing where older workers perform task with younger and more energetic worker.

Implication for future research

The authors encourage future studies to explore the relationship between the level of satisfaction with the CWE and the QOL of the ageing workforce. One of the facets not included in the present study is the layout of construction site. It is recommended that future research should assess the ageing workforce level of satisfaction with the layout of construction sites.

Conclusion

The study defined CWE facets as the approaches, support services, adjustments, practices, policies and/or procedures that organisations implement which can positively or negatively impact the health, safety, comfort, productivity and QOL of older workforce (adopted from Choi, 2015; Vischer, 1989). The study identified 18 CWE facets through a thorough review of literature and were further evaluated using close-ended questionnaire survey. The 18 facets were further reduced using principal component factor analysis into 5 principal components termed as organizational-psychological environment; physical environment; functional environment; policies and practices environment; and auxiliary environment.

The older workers were asked to rate how satisfied they felt about the 18 CWE facets. The level of satisfaction was measured with a five-point Likert scale ranging from 1 (very dissatisfied) to 5 (very satisfied). The mean scores of the responses were used to rank each facet to provide a clearer understanding of the agreement reached by all the respondents. The older workers were most satisfied with the functional environment, followed by the auxiliary environment, policies and practices environment, physical environment and lastly, organizational-psychological environment.

The study recommended that the construction industry to put in more effort in making the CWE very satisfying to all workers especially the ageing workforce. A very satisfying CWE should compensate and amend the losses accompanying ageing; critical attention should be given to the identified CWE facets to reinforce recovery, adaptation and psychological growth amongst the older workers.

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Table 1: Construction work environment (CWE) facets

Construction Work Environment (CWE) Facet	Source
Job Security/Employment tenure	Leaviss *et al*. (2008); Buckle *et al*. (2008); Bell (2015)
Salary	Leaviss *et al*. (2008); Bell (2015); Lynch *et al*. (2000); Takim, Talib and Nawawi (2016)
Payment structure (eg. Day rate payment/piecework payment)	Leaviss *et al*. (2008)
Employment flexibility (eg. Part-time)	Leaviss *et al*. (2008)
Shift-work patterns	Leaviss *et al*. (2008); Buckle *et al*. (2008)
Career opportunities/advancement	Buckle *et al*. (2008); Bell (2015); Vischer (2007)
Managerial attitude	Buckle *et al*. (2008); Vischer (2007); Eaves *et al*. (2016); Aulin *et al*. (2009)
Management plan and style	Vischer (2007); Eaves *et al*. (2016); Bell (2015); Aulin *et al*. (2009)
Personal protective equipment (PPE)	Leaviss *et al*. (2008); Eaves *et al*. (2016)
Environmental exposures such as heat, dust, noise and weather	Leaviss *et al*. (2008); Buckle *et al*. (2008); Boschman *et al*. (2013)
Repetitive task (eg. Hammering)	Leaviss *et al*. (2008)
Manually handling heavy materials	Leaviss *et al*. (2008); Eaves *et al*. (2016)
Performing wet work	Leaviss *et al*. (2008)
Task allocation/schedule approach (eg. Job rotation and job sharing)	Leaviss *et al*. (2008); Buckle *et al*. (2008); Eaves *et al*. (2016)
Engaged in more skilled, but less physically demanding task (eg. Training and Health & Safety role)	Leaviss *et al*. (2008)
Tools and equipment	Leaviss *et al*. (2008); Buckle *et al*. (2008)
Social networks (opportunity to socialise)	Buckle *et al*. (2008); Boschman *et al*. (2013); Portero and Oliva (2007)
Environmental control (eg. Empowerment)	Vischer (2007)

Table 2: Construction work environment (CWE) facets

Construction Work Environment (CWE) Facet	Code
Job security/employment tenure	CF1
Salary	CF2
Payment structure	CF3
Employment flexibility	CF4
Shift-work patterns	CF5
Career opportunities/advancement	CF6
Attitudes of management	CF7
Management plan and style	CF8
Fitting of your personal protective equipment (PPE)	CF9
Protection from environmental exposures such as heat, dust, noise and weather	CF10
Performing repetitive tasks	CF11
Manual handling of heavy materials	CF12
Performing wet task	CF13
Task allocation/schedule approach	CF14
Engagement in more skilled, but less physically demanding task	CF15
Tools and equipment	CF16
Social networks (opportunity to socialise) in the workplace	CF17
Environmental control	CF18

Table 3: Cronbach's reliability test, KMO and Bartlett's test

Cronbach's Alpha		.853
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.616
Bartlett's Test of Sphericity	Approx. Chi-Square	432.516
	df	153
	Sig.	.000

Table 4: Correlation matrix of factor analysis

Facet	CFI	CF2	CF3	CF4	CF5	CF6	CF7	CF8	CF9	CF10	CF11	CF12	CF13	CF14	CF15	CF16	CF17	CF18
CF1	1.000																	
CF2	.603	1.000																
CF3	.470	.388	1.000															
CF4	.295	.089	.216	1.000														
CF5	.609	.359	.391	.695	1.000													
CF6	.629	.413	.401	.567	.630	1.000												
CF7	.418	.226	.360	.401	.562	.564	1.000											
CF8	.549	.427	.372	.287	.581	.502	.833	1.000										
CF9	.122	-.046	-1.25	.164	.127	-.010	-.075	.101	1.000									
CF10	-.055	-.215	.051	.286	.160	.033	-.192	-.110	.445	1.000								
CF11	-.044	-.073	.328	.065	.091	.027	.292	.054	.127	-.065	1.000							
CF12	-.093	-.010	.199	.223	.187	.080	.294	.096	.208	-.028	.790	1.000						
CF13	-.014	-.023	.348	.400	.140	.229	.366	.181	.120	-.013	.636	.752	1.000					
CF14	.319	.117	.395	.510	.373	.342	.367	.268	.019	-.247	.370	.430	.521	1.000				
CF15	.195	.260	.299	.209	.089	.325	.005	.096	-.313	-.156	-.125	-.205	.101	.247	1.000			
CF16	.000	-.082	-.159	.054	.244	.000	.000	.000	.000	-.075	.060	.235	.067	.188	.154	1.000		
CF17	.351	.252	.188	.182	.386	.416	.481	.418	-.185	-.216	.070	.162	.145	.394	.308	.537	1.000	
CF18	.416	.286	.382	.593	.622	.528	.572	.430	-.205	-.243	.267	.326	.415	.653	.271	.328	.415	1.000

Table 5: Communalities

Code	Initial	Extraction
CF1	1.000	.718
CF2	1.000	.602
CF3	1.000	.668
CF4	1.000	.808
CF5	1.000	.813
CF6	1.000	.699
CF7	1.000	.767
CF8	1.000	.789
CF9	1.000	.638
CF10	1.000	.746
CF11	1.000	.799
CF12	1.000	.865
CF13	1.000	.802
CF14	1.000	.659
CF15	1.000	.730
CF16	1.000	.806
CF17	1.000	.717
CF18	1.000	.746

Extraction method: Principal component analysis.

Table 6: Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.858	32.543	32.543	5.858	32.543	32.543	4.414	24.521	24.521
2	2.680	14.891	47.434	2.680	14.891	47.434	3.265	18.138	42.659
3	1.972	10.955	58.389	1.972	10.955	58.389	1.945	10.808	53.467
4	1.513	8.403	66.792	1.513	8.403	66.792	1.871	10.394	63.860
5	1.299	7.218	74.010	1.299	7.218	74.010	1.827	10.150	74.010
6	.984	5.466	79.476						
7	.758	4.212	83.688						
8	.651	3.616	87.304						
9	.541	3.007	90.311						
10	.437	2.429	92.740						
11	.350	1.942	94.682						
12	.268	1.490	96.172						
13	.195	1.083	97.255						
14	.180	.999	98.254						
15	.134	.745	98.999						
16	.073	.407	99.406						
17	.069	.381	99.787						
18	.038	.213	100.000						

Extraction method: Principal component analysis.

Table 7: Rotated component matrix[a]

	Component				
	1	2	3	4	5
CF8	.864				
CF1	.820				
CF7	.766				
CF5	.719				
CF6	.712				
CF2	.663				
CF18	.501				
CF3	.500				
CF12		.899			
CF11		.881			
CF13		.869			
CF14		.573			
CF15			.826		
CF10				.832	
CF9				.645	
CF4				.628	
CF16					.890
CF17					.661

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Table 8: Ranking of level of satisfaction

Code	Construction Work Environment (CWE) Facet	Mean	Rank	Std. Deviation	Std. Error of Mean
	Component 1 – Organisational-Psychological	**3.60**	**5th**	**.835**	**.135**
CF3	Payment structure	3.71	1st	.654	.106
CF6	Career opportunities/advancement	3.66	2nd	.745	.121
CF2	Salary	3.63	3rd	.633	.103
CF8	Management plan and style	3.63	4th	.883	.143
CF7	Attitudes of management	3.63	5th	.913	.148
CF1	Job security/employment tenure	3.63	6th	1.051	.170
CF18	Environmental control	3.53	7th	.951	.154
CF5	Shift-work patterns	3.37	8th	.852	.138
	Component 2 – Physical	**3.72**	**4th**	**.838**	**.136**
CF11	Performing repetitive tasks	3.89	1st	.863	.140
CF12	Manual handling of heavy materials	3.84	2nd	.886	.144
CF13	Performing wet task	3.68	3rd	.775	.126
CF14	Task allocation/schedule approach	3.45	4th	.828	.134
	Component 3 – Functional	**4.08**	**1st**	**.673**	**.109**
CF15	Engagement in more skilled, but less physically demanding task	4.08	1st	.673	.109
	Component 4 – Policies and Practices	**3.78**	**3rd**	**.778**	**.126**
CF9	Personal protective equipment (PPE)	4.45	1st	.686	.111
CF10	Protection from environmental exposures such as heat, dust, noise and weather	3.89	2nd	.689	.112
CF4	Employment flexibility	3.00	3rd	.959	.156
	Component 5 – Auxiliary	**3.84**	**2nd**	**.648**	**.105**
CF16	Tools and equipment	4.00	1st	.520	.084
CF17	Social networks (opportunity to socialise) in the workplace	3.68	2nd	.775	.126

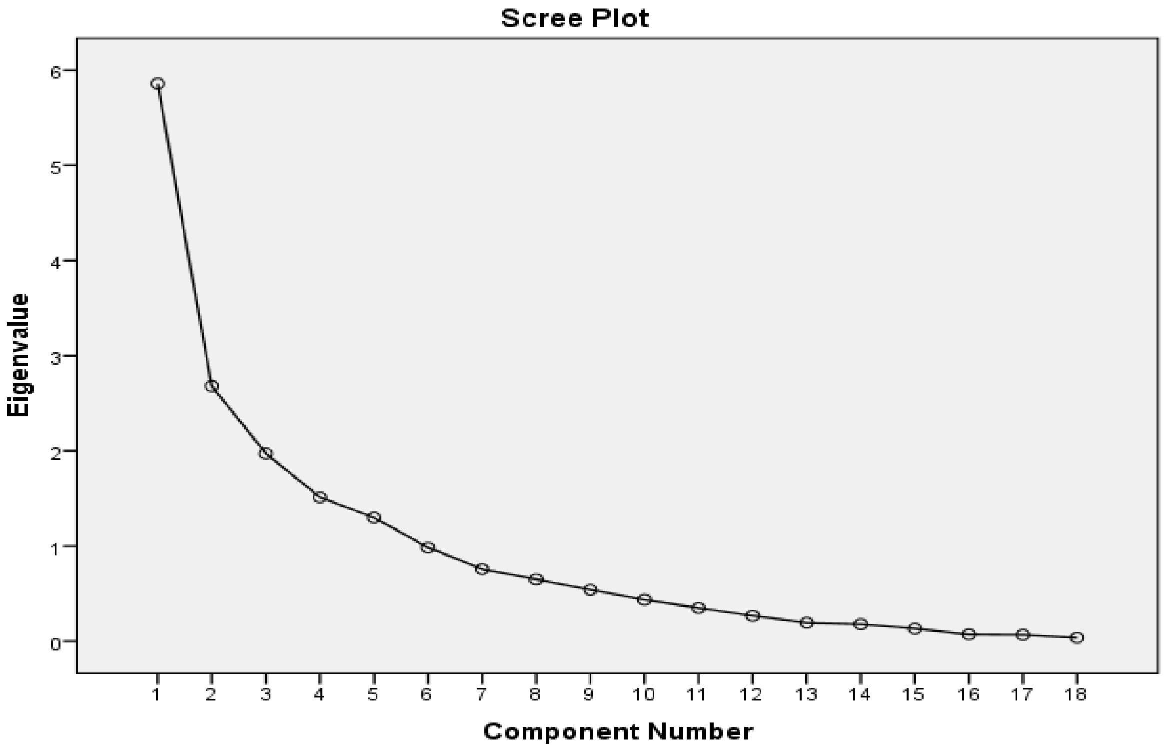

Figure 1: Scree for factor analysis