

1 **Are the Ageing Workforce Satisfied with the**
2 **Construction Work Environment?**

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9 **Abstract.** The construction industry is experiencing a shortage of workforce and
10 skill gap due to the significant reduction in the younger workers entering the
11 construction industry compared to the exponential number of retiring workers.
12 Providing ageing workforce with a satisfactory construction work environment
13 (CWE) can be one of the ways to encourage them to remain in the construction
14 industry. Therefore, this study aims to assess the level of satisfaction of the
15 ageing workers with the CWE. The study adopted a quantitative approach and
16 data was sourced from older construction workers in Edinburgh, Scotland using
17 a questionnaire survey. Factor analysis and mean score analysis were employed
18 to assess the older workers level of satisfaction with the CWE. The study
19 identified five components of the CWE termed as organisational-psychological
20 environment, physical environment, functional environment, policies and
21 practices environment and auxiliary environment. The older workers were most
22 satisfied with the functional environment, followed by the auxiliary environment,
23 policies and practices environment, physical environment and lastly,
24 organisational-psychological environment. The study recommended that the
25 construction industry put in more effort in making the CWE very satisfying to all
26 workers especially the ageing workforce. A very satisfying CWE should
27 compensate and amend the losses accompanying ageing. The authors encourage
28 future studies to explore the relationship between the level of satisfaction with
29 the CWE and the quality of life of the ageing workforce.

30 **Keywords:** Ageing, Older Workforce, Construction Work Environment,
31 Construction Industry.

32 **1 Introduction**

33 Population ageing has been one of the most significant social transformers of the
34 twenty-first century with implications on virtually all sectors of the society, including
35 the labour and financial markets, demand for goods and services and family structures
36 [1]. The labour market will experience a shortage of workforce and skill gap in the next
37 few years because the number of young people entering the workforce will significantly

38 reduce compared to the number of people retiring [2]. The proposed solution to this
39 dilemma is to make better or more flexible use of older workers and encourage them to
40 stay in work longer [2]. Interestingly, the population of older workforce that forego
41 retirement is increasing exponentially due to changes in retirement policies [3]. The
42 trend of the aged remaining in the workforce has the potential to improve a nation's
43 economy. Consequently, companies support the initiative of retaining their older
44 employees due to the valuable knowledge and experience they possess [3], [4]. This
45 implies that within the next few years the current workplaces need to be re-designed
46 not just to accommodate the ageing workforce but also to improve their quality of life
47 (QOL), so they can age healthy and remain in the workforce for as long as possible.
48 Therefore, the present study aims to assess the level of satisfaction of ageing workforce
49 with the construction work environment.

50 **1.1 The construction work environment (CWE)**

51 The environment has been generally agreed as one of the important domains of QOL
52 [5], [6]. However, the CWE is one of the most hazardous in almost every country. The
53 picture painted is always a poor work environment. The nature of work in the CWE is
54 described as tough, heavy and physically demanding [7], [8]. The CWE is unfavourable
55 for workers of all ages; however this environment can only catalyse the deteriorating
56 ageing changes of ageing workforce [8]. The proposed solution to this dilemma is to
57 properly evaluate and modify the CWE to complement the needs of the ageing
58 workforce [4].

59 As increasing older construction workforce forgo retirement and spend most of their
60 time on construction site, they will need to depend on the environment on construction
61 sites to overcome or compensate for the multiple and increasing physical impairments
62 such as vision, hearing, strength, balance, and response time [9]. Environmental
63 psychology researchers have devoted attention and resources on researching about the
64 influences of the built and natural environments on the health, comfort, safety,
65 behaviour and attitudes of occupants [10]. According to environmental psychologist,
66 QOL largely depends on understanding the needs of the older workforce. The degree
67 to which the older workforce needs are met determines their QOL [10]. This means that
68 providing a healthy and comfortable CWE is fundamental to promoting and
69 maintaining the QOL of not only the older workforce but also, the younger workforce.

70 In relations to this study, the CWE facets are the approaches, support services,
71 adjustments, practices, policies or procedures that organisations implement which can
72 positively or negatively impact the health, safety, comfort, productivity and QOL of
73 older workforce (adopted from [3], [11]). The rationale is to improve person-
74 environment fit by identifying facets in the CWE that affects fit between the older
75 workforce and the CWE. Upon a critical literature review, 18 CWE facets were
76 identified. These facets are listed in Table 1.

77 2 Methods

78 A total of eleven ongoing construction projects in Edinburgh, Scotland were invited to
 79 participate in the study. However, only five agreed to participate in the study. Purposive
 80 sampling technique was used to select older workers amongst all worker in the five
 81 construction projects. Older workers refer to participants who were aged 40 years and
 82 above (see [4], [12]). A total of 100 questionnaires were administered to older
 83 workforce, and 38 completed questionnaires were retrieved, representing a response
 84 rate of 38 per cent. Albeit the sample size was relatively small, statistical analysis could
 85 still be performed because according to the generally accepted rule, with a sample size
 86 of 30 or above, the central limit theorem holds [13]. A five-point Likert scale ranging
 87 from 1 (very dissatisfied) to 5 (very satisfied) was used to determine how the older
 88 adults were satisfied with the facets shown in Table 1. Due to a large number of
 89 variables (18 facets), factor analysis was used to identify facets that measure the same
 90 underlying construct.

91 **Table 1.** CWE facets and reliability results

Code	CWE Facet	Source
CF1	Job Security/Employment tenure	[4], [12], [14]
CF2	Salary	[4], [14], [15], [16]
CF3	Payment structure	[4]
CF4	Employment flexibility	[4]
CF5	Shift-work patterns	[4], [12]
CF6	Career opportunities/advancement	[12], [14], [17]
CF7	Managerial attitude	[12], [17], [8], [18]
CF8	Management plan and style	[17], [8], [14], [18]
CF9	Personal protective equipment	[4], [8]
CF10	Environmental exposures such as heat, dust, noise and weather	[4], [12], [19]
CF11	Repetitive task	[4]
CF12	Manually handling heavy materials	[4], [8]
CF13	Performing wet work	[4]
CF14	Task allocation/schedule approach	[4], [12], [8]
CF15	Engaged in more skilled, but less physically demanding task	[4]
CF16	Tools and equipment	[4], [12]
CF17	Social networks	[12], [19], [20]
CF18	Environmental control	[17]

92 3 Results

93 The overall Cronbach alpha value of the 18 facets is 0.853 which is higher than 0.7.
 94 This implies that there is a good internal consistency and reliability with the dataset and
 95 the five-point Likert scale adopted for the study [21]. The KMO value for the 18 facets
 96 is 0.616 which is higher than 0.5, confirming that factor analysis is appropriate for the

97 study [21], [22]. The facets were further subject to principal component analysis with
 98 varimax rotation. The number of components to be extracted was determined using both
 99 Guttman-Kaiser rule and the Cattell scree test. Guttman-Kaiser rule suggests that
 100 factors with eigenvalue greater than one should be retained. Therefore, five components
 101 with eigenvalue greater than 1.00 were extracted with varimax rotation after six
 102 iterations, explaining 74.010 per cent (see Table 2) of the total variance. The level of
 103 satisfaction with each of the five components is derived using mean score analysis as
 104 shown in Table 3.

105 **Table 2.** Total variance explained

Com	IE			ESSL			RSSL		
	Total	% Var	Cum %	Total	% Var	Cum %	Total	% Var	Cum %
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						

106 C=Component IE= Initial Eigenvalues ESSL= Extraction Sums of Squared Loadings RSSL= Rotation
 107 Sums of Squared Loadings Cum=Cumulative Var=Variance

108 **4 Discussion**

109 The organisational-psychological environment has the potential to positively or
 110 negatively affect the mental well-being of older workforce. A dissatisfaction in these
 111 factors can lead to constant mental stress for older workforce [19]. The level of
 112 satisfaction falls in between 'neither satisfied nor dissatisfied' and 'satisfied' according
 113 to the level of satisfaction scale adopted. The older workers were not very satisfied with
 114 their payment structure, salary, job security/employment tenure and career
 115 opportunities/advancement plausible because the construction industry is very
 116 competitive, and most contracts are won based on price and time for completion.
 117 Consequently, determining the salary and payment structure which gives financial
 118 reward for speed. This environment that rewards speed is unfavourable for older

119 workers who are experiencing increasing physical impairments which affects their
 120 speed. Obviously, the older worker would perceive this as discrimination and threat to
 121 their job security and career advancement in the construction industry. As argued by
 122 [4] and [16] salary inequality and discrimination treatment affect CWE. Furthermore,
 123 the older workers were somewhat not very satisfied with their management plan and
 124 style, attitudes of management, environmental control and shift-work pattern. The
 125 temporary nature of construction projects resulting in different management on a
 126 different project can inhibit management-worker relationship. Different projects come
 127 with a different management plan, style and attitude towards the older worker. A
 128 mismatch between the environment created by different management and the older
 129 workers preferences can cause psychological stress which affects job performance,
 130 health, well-being and QOL [12], [14]. Furthermore, the degree of environmental
 131 choice or empowerment older workforce feel they have through decision-making
 132 processes can also impact the QOL in the construction industry [17].

133 **Table 3.** Ranking of CWE Facets

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

134 SD=Standard deviation SEM=Standard error of mean

135 The physical environment deals with how tasks are performed within the
 136 construction industry. The level of satisfaction falls in between ‘neither satisfied nor
 137 dissatisfied’ and ‘satisfied’ according to the level of satisfaction scale adopted. The
 138 construction industry is dominated with repetitive tasks, manual handling of heavy
 139 materials, and wet works. Older workforce engaged in repetitive tasks such as
 140 hammering can lead to worsening joint problems and heavy manual tasks such
 141 bricklaying can result in MSDs, and wet tasks such as plastering can lead to rheumatic
 142 problems [4]. Since the older workers are not very satisfied with the physical

143 environment, it can be inferred that the physical environment is currently catalysing the
144 deteriorating ageing changes of the older workers. This calls for alternative measures
145 such as nail guns instead of hammer can make repetitive tasks less demanding, and the
146 same applies to manual handling aide, lifting devices and alternative materials and
147 methods to reduce wet task such as dry lining [4], [8]. Closely linked to this is how
148 tasks are allocated in the construction. Adopting task allocation approaches such as job
149 rotation and job sharing where older workers perform tasks with younger and more
150 energetic workforce can increase the older workers physical environment satisfaction
151 level.

152 The functional environment deals with engaging the older workers in construction
153 work related task and activities where their functional competence overcome or match
154 with the environment. The level of satisfaction falls in between 'satisfied' and 'very
155 satisfied' according to the level of satisfaction scale adopted. The nature of work in the
156 CWE is described as tough, heavy and physically demanding [7], [8]. Engaging older
157 workforce in unskilled tasks which are more physically demanding will only catalyse
158 the deteriorating ageing changes of ageing workforce [8]. Interestingly, most of the
159 older workers that participated in the study were engaged in skilled works that are less
160 physically demanding. For example, all the 60 and over aged group that participated in
161 the study were health and safety managers or site managers. Therefore, it is not
162 surprising that the older workforce perceived and ranked their functional environment
163 as the most satisfactory amongst others. This is plausible because their functional
164 competence increases when they are engaged in more skilled tasks.

165 This environment deals with the policies and practices that are implemented to
166 protect the older workforce from exposure to construction workplace hazards and risk
167 of injury. The level of satisfaction falls in between 'neither satisfied nor dissatisfied'
168 and 'satisfied' according to the level of satisfaction scale adopted. The older workforce
169 seems to be somewhat satisfied with current policies such as health and safety policy
170 and PPE policy. However, the older workforce will be more satisfied if these policies
171 are modified to focus more on older workforce and adequately put into practice.

172 The auxiliary environment deals with additional support and measures used to
173 sustain and boost the performance of the older workforce. The level of satisfaction falls
174 in between 'neither satisfied nor dissatisfied' and 'satisfied' according to the level of
175 satisfaction scale adopted. Tools and equipment to some extent can minimise the
176 demanding nature of task in the construction industry. However, tools and equipment
177 that are not purposively designed for older worker can be a hindrance to the functioning
178 of the older workers. Also, an excellent auxiliary environment should provide an
179 opportunity for its members to interact and socialise. Social interaction with other
180 people is a source of emotional support, companionship, instrumental help, and advice
181 [20]. The degree of loneliness and isolation experienced by older workforce somewhat
182 depends on the interaction opportunities created by the auxiliary environment [20].

183 **5 Conclusions**

184 The study identified 18 CWE facets through a thorough review of the literature and was
 185 further evaluated using close-ended questionnaire survey. The 18 facets were further
 186 reduced using principal component factor analysis into five principal components
 187 termed as organisational-psychological environment; physical environment; functional
 188 environment; policies and practices environment; and auxiliary environment. The older
 189 workers were asked to rate how satisfied they felt about the 18 CWE facets. The level
 190 of satisfaction was measured with a five-point Likert scale ranging from 1 (very
 191 dissatisfied) to 5 (very satisfied). The mean scores of the responses were used to rank
 192 each facet to provide a clearer understanding of the agreement reached by all the
 193 respondents. The older workers were most satisfied with the functional environment,
 194 followed by the auxiliary environment, policies and practices environment, physical
 195 environment and lastly, organisational-psychological environment. The study
 196 recommended that the construction industry put in more effort in making the CWE very
 197 satisfying to all workers especially the ageing workforce. A very satisfying CWE
 198 should compensate and amend the losses accompanying ageing; critical attention
 199 should be given to the identified CWE facets to reinforce recovery, adaptation and
 200 psychological growth amongst the older workers.

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