

Artificial Intelligence in Digitalised Workplaces

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Abstract:- The use of new technologies in the construction industry have contributed to the reduction in the rate of work-related musculoskeletal disorders (WMDs). The study aims to determine the variables responsible for musculoskeletal disorders and how the use of artificial intelligence has improved employee performance, and health and safety and training. The population of the study was made up construction firms in Western and Central Regions due to proximity. Snowball sampling technique was used to select the construction firms. The sample size was determine based on the number of steel benders and brick layers available during the period of the study. Questionnaire was used for the data collection, and SPSS and Excel software were used in the data analysis. The results were presented in Descriptive Statistics, Kaiser-Meyer-Olkin (KMO) Measure of Sampling, Bartlett's Test of Sphericity and Rotated Component Matrix. Out of two hundred (200) questionnaires distributed, 154 were returned representing 77% response rate. Findings show that exoskeletons can be used to improve worker efficiency and prevent musculoskeletal disorders (MSDs). Further findings show that the use of exoskeletons can contribute to the reduction of precarisation. Employee's performance can also improve through changes in an organizational policies and strategies and the use of computers to replicate human thinking. Employee's performance will also improve through extensive training. Support and approval should be given by the construction firms on the use of artificial intelligence (AI) for future development

Keywords:- Communication, Health and Safety, Job Security, Musculoskeletal Disorders, Work-Load, Work Environment.

I. INTRODUCTION

Report from International Labour Organization (ILO) shows that million workers die from occupational accidents, non-fatal occupational accidents and work-related diseases annually" (Hämäläinen et al, 2017; Takala et al, 2014). "Construction workers continue to face a higher risk of work-related musculoskeletal disorders (WMSDs) and the rate of WMSDs in construction is higher than all industries combined" (Wang et al., 2017). The major cause of WMSDs in construction was overexertion, and back injuries accounted for more than 40% of WMSDs among construction workers (Wang et al., 2017).

People are increasingly connected to digital information anywhere and at any time and this has implications for safety and health at work (Maciejewski and Dimova, 2016). One new development is the use of communication for digitized information which is a key technological development which is driving the 'fourth industrial revolution' (Garben, 2017). One key impact on safety and health at work is technological developments which in certain instances, have taken over dirty, dangerous and demeaning jobs previously undertaken by workers (IBM, 2016). A related development is the growing use of Artificial Intelligence (AI) where computers are often used to replicate human thinking and AI is increasingly used to support workers' safety and health (IBM, 2016). "Stress, musculoskeletal difficulties, discrimination, heightened precarisation, work intensification and job losses are associated with artificial intelligence (AI) in digitalised workplaces" Moore (2018a). The use of technology has also led to the replacement of workers in most of the construction activities (Biewald, 2015). This has implications for workers' job security and wellbeing as job insecurity and unemployment and underemployment can have effects on a worker's psychosocial health. A key change for the world of work has been the 'virtualization' of work, leading to an increased demand for 'flexibility' in relation to work organization, working time arrangements and telework (Stacey et al, 2016, 2017). Technological advancement can lead to changes in an organizational policies and strategies (Hampel and Martinsons, 2009). "Developments in technology affect all aspects of work, from who or what performs the work, how and where work is performed and the work that is performed, the ways in which work is organized and the terms of its performance, and the safety and health of workers" (Stacey et al, 2016, 2017). These changes and developments have a great impact on the working conditions and safety and health of workers (Stacey et al, 2016, 2017). The proliferation of automation and robotics can have benefits for a worker's safety and health, since robotics provide opportunities to remove workers from hazardous situations (European Trade Union Institute, 2017). Success of an organization is measured the attitude of its employees towards their work, while the availability of technology in the organization has an influence on employee performance (Yuvaraj and Nadheya, 2018). Some of the factors that influence the behaviour of an employee are work environment, relationship with supervisors and co-workers, job satisfaction, leadership styles, rewards system (Yuvaraj and Nadheya, 2018).

Other variables which have great impact on the performance of the employees in a particular organization are technology, motivation, management behaviour and working environment (Khan, 2012). The role of the Human Resource Management (HRM) professional has changed fundamentally as a result of technology. Since HRM can use advance technologies equipment to check and evaluate the employees' output or performance. (Abass et al 2014). Artificial intelligence (AI) exaggerates occupational safety and health (OSH) risks in digitalised workplaces because it can allow for increased monitoring and tracking, and thus, can lead to micro-management, a prime cause of stress and anxiety (Moore 2018). Workers believe that AI could improve safety, help reduce mistakes and limit routine work (Rayome 2018). Employers can motivate employees to adopt the new technology and incentives should be given to employees to enable them to improve on their performance (Dauda & Akingbade, 2011). The implementation of a new technology by an organisation should pave way for the provision of proper training to its employees (Abass et al 2014). Firms must invest on employees training to improve the employee knowledge and skills and development of employees prior to the introduction of new technology (Dauda & Akingbade, 2011). The study aims to determine the variables responsible for musculoskeletal disorders and how the use of artificial intelligence has improved employee performance, and health and safety and training.

➤ *Technological Tools for Workplace Management*

"Digitalization is one of the new technologies that can create many new jobs, those that lose their jobs as a result of job replacement may be the least equipped with the skills to seize new opportunities. Workers may be retrained in regard to safety and health risks associated with new work tasks" (ILO, 2018a). Robotics and AI can alleviate human workers from repetitive and stressful tasks which can lead to musculoskeletal disorders (MSDs) or mental health risks (European Trade Union Institute, 2017). "Exoskeletons have been used in various contexts, such as medical institutions, assembly lines, and construction. They can be useful for the prevention of musculoskeletal disorders (MSDs) and can improve worker efficiency but may carry other risks for the worker operating the equipment. For instance, powered exoskeletons can be used to modify a person's habitual physical and ergonomic movements, for example, enabling them to lift heavy weights but potentially making it harder to make more simple movements" (European Trade Union Institute, 2017). Digital platform work may be able to generate safety and health opportunities, such as increasing a worker's control over the hours they work and their work-life balance and moving work normally carried out in the informal economy into the formal sector, where there may be enhanced safety and health regulation and protection (Garben, 2017; ILO, 2018b). New opportunities also emerge from utilizing digitalization, Information and Communication Technology (ICT) and other new technologies to spread health and safety knowledge and improve workers OSH skills and training (Jeske, 2016). This can be done, for example, through health and safety apps, online training programmes, or the use of virtual and augmented reality to facilitate training. Digitalization allows

for the processing of extremely large datasets (or 'big data') in order to monitor the workplace, as well as the work itself. For example, the stress or strain that a task puts on a worker can be considered, and mitigated against when planning personnel deployment (Jeske, 2016).

➤ *Training for Artificial Intelligence and Occupational Safety and Health*

Provision of training in a new technology or for professional development leads to opportunities to perform at optimal levels (Mayhew, 2018). Artificial intelligence (AI) is a form of technology that can improve means of work by employees (Mayhew, 2018). Artificial intelligence (AI) makes work more efficient and freer from the burden of tedious, repetitive tasks (Mayhew, 2018). AI contributes to simplification of many job functions, which in turn strengthens performance and improves job satisfaction (Mayhew, 2018). The fact on the introduction of technology at work places has been supported by Yuvaraj and Nadheya (2018) who indicated that employee's performance in an organization has increased. Training for occupational safety and health (OSH) has at times been seen as an arena solely populated by the one or two health and safety officers in workplaces and not been fully integrated into all systems (Moore, 2018). This development calls for an alignment between OSH training and integrated technologies such as the AI within the work environment. There is need for the training pedagogy be adjusted, since learning is a process that will need to continue throughout workers' lifetimes particularly in the current climate of job uncertainty (Moore, 2018). Moore (2018) posited that employee should be alert to risks and employers should involve workers in providing training at times for the benefit of AI in the work environment. The use of AI can lead to a change in training landscape within an organization, for new technology itself or ongoing professional training and personal development (Mayhew, 2018). An example is the use of webinars in recent times which are an effective means of providing training at different times for employees (Mayhew, 2018). Mayhew (2018) posited that the use of technology for on-demand training may be less costly than hiring in-person facilitators to conduct learning sessions. The cost savings may be better utilized to incentivize training options.

II. METHODOLOGY

Quantitative technique was used in the administration of the questionnaires (structured and non-structured) to both skilled and unskilled labourers respectively (Creswell and Clark, 2011). The population of the research was made of skilled and non-skilled labourers in the construction industry within Western and Central Regions of Ghana. The two regions were chosen due to proximity and snowball sampling technique (where the chosen firms were referred by one firm and the other) to arrive at the required number of respondents. An intensive literature review was conducted on artificial intelligence (AI), which include the state of artificial intelligence in the construction industry, the use of artificial intelligence in reducing work related musculoskeletal disorders (WMSDs), how AI has contributed to the reduction of WMSDs in the construction

industry. A draft questionnaire was designed and distributed to bricklayers and steel benders in the Cape Coast Metropolis. The outcome of the findings from the drafted questionnaire led to the design of the final questionnaire (structured and non-structured) for the study. The questions were divided into two sections - profile of the respondents and information on impact of artificial intelligence (AI) on health and safety of employees, impact of Artificial Intelligence (AI) on employee's performance and influence of artificial intelligence on employees training. Hardcopy questionnaires were distributed by hand to the two hundred (200) respondents. Out of two hundred (200) questionnaires distributed, 154 were returned representing 77% response rate. Thirteen (13) questionnaires were partially completed, eighteen (18) had two answers and seven (7) some parts of the questionnaires removed. The remaining one hundred and sixteen (116) were used for the analysis. Statistical Package for Social Science (SPSS) and Excel software were employed in the data analysis. All the collected items from the field were coded using SPSS; The results were presented using descriptive statistics indicating frequencies mean and standard deviation. The variables under each of the objectives were subjected to principal component (PC) analysis. Constructs/ factors with 0.50 factor loading were extracted for analysis. All the variables were ranked based on the Standard Deviation (SD) to determine the influence of artificial intelligence (AI) on work related musculoskeletal Disorders (WMSDs) among steel benders and brick layers in Western and Central Regions of Ghana. The preceding section presents the findings from the study.

III. FINDINGS

Majority (85%) of the respondents who were steel benders within the age range of 36 - 40years (72%). Very few (28%) respondents were between the age range of 46years and above. The respondents' highest qualification was Diploma/Higher National Diploma, which represent 89% and have worked in the firm between 16 -20 years. Few (9%) respondents had Bachelor's degree and have spent between 6 -10 years. The remaining 11% of the respondents had either Senior School Certificate or Master's degree.

Table 1 shows a recorded mean range of 2.28 to 3.15 and a standard deviation range of 1.218 to 1.403 for the variables of Artificial Intelligence (AI) that can impact on health and safety of employees. The variable (exoskeletons can improve worker efficiency) was ranked first. The variable has recorded a mean of 2.92 and standard deviation of 1.403. This is followed by the variable (exoskeletons can be used to prevent musculoskeletal disorders (MSDs) with a mean of 2.47 and a standard deviation of 1.392. The next variable [Artificial intelligence (AI)] contributes to the reduction of precarisation) with a mean of 3.22 and a standard deviation of 1.358. AI takes over dirty, dangerous and demeaning jobs was ranked as the least among the twenty-four (24) variables that impact on health and safety of employees.

➤ Descriptive Statistics

Table 1 Impact of Artificial Intelligence (AI) on Health and Safety of Employees

Variable	N	M	SD	R
Artificial intelligence (AI) can alleviate human workers from repetitive and stressful tasks	116	2.64	1.315	6
Health and safety risks are associated with new work tasks		2.28	1.198	19
AI reduces musculoskeletal disorders (MSDs)		2.46	1.233	15
AI reduces mental health risks		2.54	1.268	11
Exoskeletons can improve worker efficiency		2.92	1.403	1
Exoskeletons can be used to prevent musculoskeletal disorders (MSDs)		2.47	1.392	2
Improvement in workers occupational safety and health (OSH) skills and training		2.40	1.291	10
Changes and developments on the working conditions		2.48	1.354	4
AI can contribute to worker's safety and health		2.35	1.340	5
Changes and development have some implications for safety and health at work		2.85	1.181	21
AI takes over dirty, dangerous and demeaning jobs		3.15	1.218	17
AI replacement of workers in most of the construction activities		3.04	1.130	24
AI is increasingly used to support workers' safety and health		3.01	1.198	8
Computers are often used to replicate human thinking		3.08	1.293	9
AI improves on job security and wellbeing of employees		2.89	1.140	23
AI removes workers from hazardous situations		3.06	1.167	20
AI contributes improvement of safety; help reduce mistakes and limit routine work		3.10	1.219	16
AI contribute to reduction of work stress		3.05	1.264	12
AI contributes to the reduction of musculoskeletal difficulties		2.96	1.182	18
AI contributes to the eliminates discrimination		3.19	1.257	14
AI reduces work intensification at work		3.01	1.261	13
AI contributes to the reduction of back injuries		3.32	1.269	10
AI contributes to the reduction of overexertion		3.21	1.302	7
AI contributes to the reduction of precarisation		3.22	1.358	3

Frequency- N; M- Mean; SD-Standard Deviation; R- Ranking.

Table 2 shows that the p-value of the KMO = 0.891 is greater than the 0.000 significance level of 0.00 for the measure of sampling adequacy; thus, for impact of Artificial Intelligence (AI) on health and safety of employees. The Bartlett's test of sphericity will be rejected at the significance level of 0.00. Thus, the correlation matrix is not an identity matrix since the p-value is less than 0.000.

Table 2 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.891
Bartlett's Test of Sphericity	Approx. Chi-Square	1941.122
	df	325
	Sig.	.000

All the variables under consideration (components 1, 2, 3, 4 and 5) as shown in Table 3 have factor loadings ranging from 0.523 to 0.840. Component 1 had factor loadings ranging from 0.533 to 0.748; component 2 had its factor loadings ranging from 0.713 to 0.790; component 3 had factor loadings ranging from 0.632 to 0.755; component 4 had factor loading ranging from 0.518 to 0.862 and component 5 had factor loading ranging from 0.564 to 0.690. Hence, all the variables were found to have influence that can impact on health and safety of employees.

Table 3 Rotated Component Matrix

	Component Factor loadings				
	1	2	3	4	5
Developments in technology affects the safety and health of workers	.639				
Changes and developments have a great impact on safety and health of workers	.622				
Some implications for safety and health at work	.714				
AI takes over dirty, dangerous and demeaning jobs	.683				
Replacement of workers in most of the construction activities	.748				
AI is increasingly used to support workers' safety and health	.721				
Computers are often used to replicate human thinking	.559				
Job security and wellbeing	.728				
Removes workers from hazardous situations	.687				
Improve safety, help reduce mistakes and limit routine work	.533				
Reduces work intensification		.713			
Reduces back injuries		.817			
Decreases overexertion		.840			
Reduces precarisation		.790			
Exoskeletons can be used to prevent musculoskeletal disorders (MSDs)			.747		
Improvement in workers occupational safety and health (OSH) skills and training			.671		
Changes and developments have a great impact on the working conditions			.643		
AI can have benefits for a worker's safety and health			.755		
Exoskeletons can improve worker efficiency			.632		
Artificial intelligence (AI) can alleviate human workers from repetitive and stressful tasks				.518	
Health and safety risks are associated with new work tasks				.862	
AI reduces musculoskeletal disorders (MSDs)				.822	
Artificial intelligence reduces mental health risks				.700	
Reduces work stress					.690
Reduces musculoskeletal difficulties					.523
Eliminates discrimination					.564

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

Table 4 shows a recorded mean range of 2.02 to 3.79 and a standard deviation range of 1.111 to 1.545 for the variables of impact of Artificial intelligence (AI) on employee's performance. The variable (changes in an organizational policies and strategies) was ranked first. The variable has recorded a mean of 2.85 and standard deviation of 1.545. This is followed by the variable (loss of job

security and wellbeing of employees) with a mean of 2.84 and a standard deviation of 1.497. The next variable (computers are often used to replicate human thinking) with a mean of 3.12 and a standard deviation of 1.458. Increased monitoring and tracking was ranked as the least among the seventeen (17) variables that impact on employee's performance.

➤ *Impact of Artificial Intelligence (AI) on Employee's Performance*

Table 4 Descriptive Statistics

	N	M	SD	R
Digitalization creates new jobs	116	3.18	1.262	11
Few workers are retrained		3.15	1.253	12
Workers with minimum skills easily lose their jobs as result of digitalization		3.63	1.289	10
Digital platform work can increase worker's control over the hours they work		3.29	1.439	4
Developments in technology affect the terms of its performance		3.22	1.222	14
Create opportunities to perform at optimal levels		3.34	1.293	9
Artificial intelligence (AI) improves means of work by employees		3.14	1.311	7
Changes and developments have a great impact on the working conditions		3.38	1.336	6
Digitalization helps to monitor workplace and the work itself		3.79	1.296	8
AI replacement of workers in most of the construction activities		3.47	1.380	5
Computers are often used to replicate human thinking		3.12	1.458	3
Loss of job security and wellbeing of employees		2.84	1.497	2
Changes in an organizational policies and strategies		2.85	1.545	1
Employee performance is influenced by technology in an organization		1.97	1.190	16
Increased monitoring and tracking		2.02	1.111	17
Eliminates discrimination		2.27	1.211	15
Reduces work intensification		2.34	1.238	13

Frequency- N; M- Mean; SD-Standard Deviation; R- Ranking

Table 5 shows that the p-value of the KMO = 0.887 is greater than the 0.000 significance level of 0.00 for the measure of sampling adequacy; thus, for impact of Artificial Intelligence (AI) on employee's performance. The Bartlett's test of sphericity will be rejected at the significance level of 0.00. Thus, the correlation matrix is not an identity matrix since the p-value is less than 0.000.

Table 5 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.887
Bartlett's Test of Sphericity	Approx. Chi-Square	1301.907
	df	171
	Sig.	.000

All the variables under consideration (components 1, 2 and 3) as shown in Table 6 have factor loadings ranging from 0.532 to 0.843. Component 1 had factor loadings ranging from 0.591 to 0.840; component 2 had its factor loadings ranging from 0.566 to 0.843 and component 3 had factor loadings ranging from 0.532 to 0.748. Hence, all the variables were found to have influence on employee's performance.

Table 6 Rotated Component Matrix

	Component Factor Loadings		
	1	2	3
Digitalization creates new jobs	.655		
Few workers are retrained	.622		
Workers lose their jobs as result of digitalization	.737		
Workers with minimum skills easily lose their jobs	.840		
Digital platform work can increase worker's control over the hours they work	.780		
Digitalization helps to monitor workplace and the work itself	.591		
Job security and wellbeing		.566	
Changes in an organizational policies and strategies		.573	
Employee performance is influenced by technology in an organization		.798	
Increased monitoring and tracking		.843	
Eliminates discrimination		.780	
Reduces work intensification		.731	
Leads to job losses			.596
Developments in technology affect the terms of its performance			.581
Create opportunities to perform at optimal levels			.575

Artificial intelligence (AI) improves means of work by employees			.748
Changes and developments have a great impact on the working conditions			.671
Replacement of workers in most of the construction activities			.532
Computers are often used to replicate human thinking			.567

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

Table 7 shows a recorded mean range of 2.84 to 3.63 and a standard deviation range of 1.253 to 1.545 for the variables of Artificial Intelligence (AI) that can influence employee training. The variable (on-demand training is less costly) was ranked first. The variable has recorded a mean of 2.85 and standard deviation of 1.545. This is followed by the variable (worker’s performance will improve) with a mean of 2.84 and a standard deviation of 1.497. The next variable (strengthening work performance) with a mean of 3.34 and a standard deviation of 1.450. Artificial intelligence (AI) makes work more efficient was ranked as the least among the ten (10) variables that influence on employees training.

➤ *Influence of Artificial Intelligence on Employees Training*

Table 7 Descriptive Statistics

	N	M	SD	R
AI makes work more efficient	116	3.15	1.253	9
Strengthening work performance		3.34	1.450	3
Simplification of many job functions		3.63	1.289	8
Improvement in job satisfaction		3.29	1.439	4
Integration of new technologies with OSH training		3.22	1.222	
Employee’s area often alerts to risks		3.34	1.293	7
Change in training landscape within an organization		3.14	1.311	6
The use webinars at different times for employees		3.38	1.336	5
Worker’s performance will improve		2.84	1.497	2
On-demand training is less costly		2.85	1.545	1

Frequency- N; M- Mean; SD-Standard Deviation; R- Ranking.

Table 8 shows that the p-value of the KMO = 0.892 is greater than the 0.000 significance level of 0.00 for the measure of sampling adequacy; thus, for influence of artificial intelligence on employees training. The Bartlett’s test of sphericity will be rejected at the significance level of 0.00. Thus, the correlation matrix is not an identity matrix since the p-value is less than 0.000.

Table 8 KMO and Bartlett’s Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.892
Bartlett's Test of Sphericity	Approx. Chi-Square	788.762
	df	78
	Sig.	.000

Almost all the variables under components 1 and 2 have factor loading greater than 0.50, with the exception of on one variable (on-demand training is less costly) as shown in Table 9. The remaining variables under components 1 and 2 have factor loadings ranging from 0.524 to 0.861. Component 1 had factor loadings ranging from 0.493 to 0.861 and component 2 had its factor loadings ranging from 0.524 to 0.782. Hence, almost all the variables were found to have influence on employees training

Table 9 Rotated Component Matrix

	Component Factor Loading	
	1	2
AI makes work more efficient	.614	
Strengthening work performance	.798	
Simplification of many job functions	.861	
Improvement in job satisfaction	.821	
Provision of different types of motivation	.599	
On-demand training is less costly	.493	
Integration of new technologies with OSH training		.524
Employee’s area often alerts to risks		.546
Change in training landscape within an organization		.734
The use webinars at different times for employees		.681
Good behaviour of management		.583

Good work environment		.748
Worker's performance will improve		.782

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

IV. SUMMARY OF FINDINGS

Most of the employees were at their middle age and very strong with a tertiary education which can keep them in active job for a long period. The impact artificial intelligence (AI) in the construction industry. On the employee's health and safety, exoskeletons can be used to improve worker efficiency and prevent musculoskeletal disorders (MSDs). It can also contribute to the reduction of precarisation. On the employee's performance, it was clearly shown that changes in an organizational policies and strategies, loss of job security and wellbeing of employees and the use of computers to replicate human thinking were the major changes to be employed in the construction industry. On the employee's training, it was found that employee's performance will improve and strengthening work performance. All the variables under impact of AI on employee's health and safety and employee's performance were found to be very influential in improving on employee's health and safety and performance. Few of the variables under the impact of AI on employee's training were not considered to be very influential.

V. CONCLUSIONS AND RECOMMENDATIONS

The study sought to determine the variables responsible for musculoskeletal disorders and how the use of artificial intelligence has improved employee performance, and health and safety and training. There has been improvement on construction employee's health and safety, performance and training due to the application artificial intelligence (AI). It is recommended that construction firms should support and approve on the use of artificial intelligence (AI) for future development. The variables under employee's training should be strengthen and upgraded from ten (10) to a minimum of fifteen (15) variables to include other aspects of employee's training that were not included in the study.

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