Constructive ageing: a survey of workers in the construction industry

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Abstract (100 – 200 words)
The age demographic of the workforce is increasing across Europe (Griffiths 1997, Morschhäuser, Sochert 2006, Ilmarinen 2006) and the World (Ross 2010). It is important to investigate the effects of workplace design on healthy ageing. To facilitate this, a questionnaire survey (n=106) was used to identify workplace opportunities and barriers to working later into life at a major UK construction company as part of a larger cross-industry study (n=815?). At this company ~33% (n=29) of respondents were aged ≥50. The survey investigated the impacts of workplace equipment and environments on people's ability to perform job tasks in relation to age. Participants were asked to respond to statements and questions about; musculoskeletal symptoms, work ability, their work environment, equipment, activities and personal attitudes and experiences towards ageing in the workplace. The survey findings were triangulated by interviewing a sample of workers. At this company, musculoskeletal symptoms peaked for period prevalence in the lower back 44% (n=42), followed by the knees 33% (n=32). Point prevalence of reported musculoskeletal symptoms was highest in the knees, 24% (n=23). Several respondents also directly attributed the symptoms to work tasks. The equipment regularly used to perform job tasks included; computers, furniture, PPE as well as many hand tools. Workplace equipment to perform job tasks, the environment and work activities, can impact on musculoskeletal symptoms experienced by respondents.
(221words)

Keywords: Construction, Survey, Ageing, Design, Health

Introduction

Workplaces can have a major influence on a person's health, when coupled with an ageing demographic it is important to not just act on existing health issues but to prevent reoccurrence or indeed the onset of work related ill health on existing and new employees. The workplace environment and equipment (WEE) used to perform job tasks need to meet the requirement of needs of the workforce thought their life course (Winn 2000, Moyers, Coleman 2004). It is hoped that by employing user-centred design methods, WEE can reflect the needs and aspirations of the users by learning from and working with expert users to investigate prevention of injury and illness as people age at work. The research team recognises the particular challenges of workplace design in the construction industry where the workface environment is continually changing (Gibb et al, 2006). This may be why so little serious work has been done in this area in construction.

The New Dynamics of Ageing (NDA) research programme[1] investigates the effects of "older ageing". The authors' "Working Late" ageing productively through design project forms part of the NDA research programme and has been designed to address work-related healthy ageing. The output of this research will be web based resource; *Organiser for Working Late* (OWL). It is important to investigate and understand the impacts of WEE design on working

[1] The New Dynamics of Ageing (NDA) research programme is funded by the ESRC, BBSRC, AHRC, EPSRC and MRC. This project forms part of a Collaborative research project which investigates the effects of ageing whist working later into life and for this projects how design solutions can facilitate, promote and improve the quality of life for older workers (NDA 2010).

populations, including potential injuries and work related ill health. To do this, a large questionnaire survey was conducted across the main UK industries the results from one of the participating companies, a large construction firm, are presented and discussed in this paper.

Three construction sites managed by this company were involved in this study. Employees demonstrated that they use many different pieces of equipment in multiple and changeable work environments. Some of these are potentially hazardous and can affect health at work and, as such, great care is taken by the company in relation to worker safety.

Methods

Construction work involves a large cross-section of different workers and skill sets, the jobs these workers perform also vary depending on their job tasks and WEE. Therefore it was important that the sampling process encouraged participation from people working in a broad cross-section of jobs within the company, this included both the office and site based employees as well as people who were involved in traditional construction type work as well as sedentary work. The number of workers at each of the three sites varied depending on the stage of construction. Each site was within an enclosed compound, had portable cabin offices and an active building site. The total workforce for all three sites, at the time of the questionnaire survey, was ~400 people including subcontractors and office staff.

The questionnaire survey was developed and piloted. The Loughborough University Ethical Committee guidance checklist (Loughborough University 2004) was used to evaluate any ethical considerations. Companies were then invited to participate in the research. Meetings were set up where it was discussed how best to encourage participation from employees. For this company, a paper version was made available to staff not on the work email system, this was distributed by the researcher on accompanied site visits. The questionnaire surveys were handed out to employees and then either returned directly to the researcher or in sealed envelopes to an administrator who then forwarded them onto the researchers at Loughborough. An electronic copy was made available through a link in the email (Williams et al. 2010) this was sent to employees with a company email address. The site visits also provided the researcher with the opportunity to meet senior health, safety and environment advisors and gain their support as well as to meet with employees and answer any immediate questions they had about the research, this combination was felt to help increase the response rate.

Participants were asked to respond to six different sections in the self completed questionnaires as presented by Williams et al (2011); about your employer & your employment status, about the environment in which you work today, doing your job, job demands, you & your work and about you. As a way of thanking respondents for their time participating in the study, their names were put into a prize draw.

The results in this paper are based on the responses received; therefore they only provide an overview of the employees working at these three sites of this company and not individual worker populations.

Results

A total of 106 surveys from this company were received by the research team (70 were paper based and 36 electronic). The response rate was believed to be ~26% (n=106) of the working population of all three sites (n=~400). Questionnaire surveys were removed from the final data set where respondents did not indicate their year of birth, gender or did not respond to any part of the NMQ. This left a sample size of 96 respondents. Table 1 provides some basic descriptive statistics from this sample;

Table 1. Descriptive statistics

Descriptive	***n***			**Mean**
Gender	96	87.5% Male	12.5% female	
Age	96	70% ≤49 years	30% ≥50 years	41.5 years
Length of time working for organisation	92	62% ≤11.9 years	38% ≥12 years	11.9 years (SD 11.1)
Length of time in current job role	93	66% ≤9.2 years	34% ≥9.3 years	9.2 years (SD 10.7)
Hours worked per week	95	98% ≥35-hours	41% ≥ 44-hours	44 hours (SD 6.4)
Body Mass Index (BMI)	91	34% = 18.5 – 24.9 (normal)	72% ≥ 25 (overweight/obese)	27.2 (SD 4.2)

In order to understand the needs of any given population it is important to understand more than just the physical demands placed upon them. To aid this, participants were asked to respond to several statements and questions throughout the questionnaire survey in relation to their thoughts and perceptions of their work ability and ageing as well as how they felt their WEE affected their ability to work. To explore the needs of the workforce that participated in this study, it was important to understand their attitudes towards their jobs and age. Participants were asked to indicate their responses to 13 statements, with each statement based on a five point scale ranging from; strongly agree to strongly disagree (see Williams et al. 2011). To establish if a trend was present, responses were grouped as either being; positive "strongly agree and agree", or negative "disagree and strongly disagree", and were then analysed by age groups; people aged ≤49 (n=67) and ≥50 (n=29). Five of the 13 statements (Table 2) showed that there was a statistically significant difference (p≤0.05) in the responses from both groups, based upon two-tailed independent samples t-test.

Table 2. The five work related statements which showed statistically significant (p≤0.05) differences according to age group; ≤49 and ≥50

Statement	**p-value; Age groups ≤49 and ≥50 Statistical difference**	**Greater level of positive agreement**
I feel my age has made me less physically active at work than I used to be	Yes (0.002)	≥50
I feel more tired now due to my job then I did when I was younger	Yes (0.008)	≥50

I find learning new skills, and technologies more difficult now than when I was younger	Yes (0.000)	≥50
My productivity and capacity to do my job has declined as I have got older	Yes (0.005)	≥50
I feel that I am not as capable as I was when I was younger at learning or retraining	Yes (0.000)	≥50

People aged ≥50 were in stronger agreement ($>p\leq0.01$) with these five statements. This suggests that people view older age as being a negative barrier to work ability, this notion is supported by findings from another case study which looked at heavy manufacturing at a cement works (Williams et al. 2011). The statement asking participants to reflect on their age and the reduction of the manual labour requirements of their job showed a greater level of agreement for people aged ≥50.

The Work Ability Index (WAI) (Tuomi et al. 2006, Ilmarinen 2007) used for this study has been used in similar case study company results (Williams et al. 2011). The WAI 'best to current' scores were high, with a mean of 8.8 (SD 1.3). High score were also achieved for the WAI physical ability score of 1.5 (SD 0.6) and WAI mental ability score of 1.5 (SD 0.7) to do their jobs.

Respondents were also asked to list five of the main pieces of equipment used when performing their work duties this was an open ended question. The researchers later categorized the equipment to aid with identifying work tasks and job types for data analysis. The items were categorized (Table 3) based on the names of the equipment and the understanding of this equipment. The largest category was "work tools and equipment" with 33% (n=151) of all items mentioned (n=456) belonging in this group.

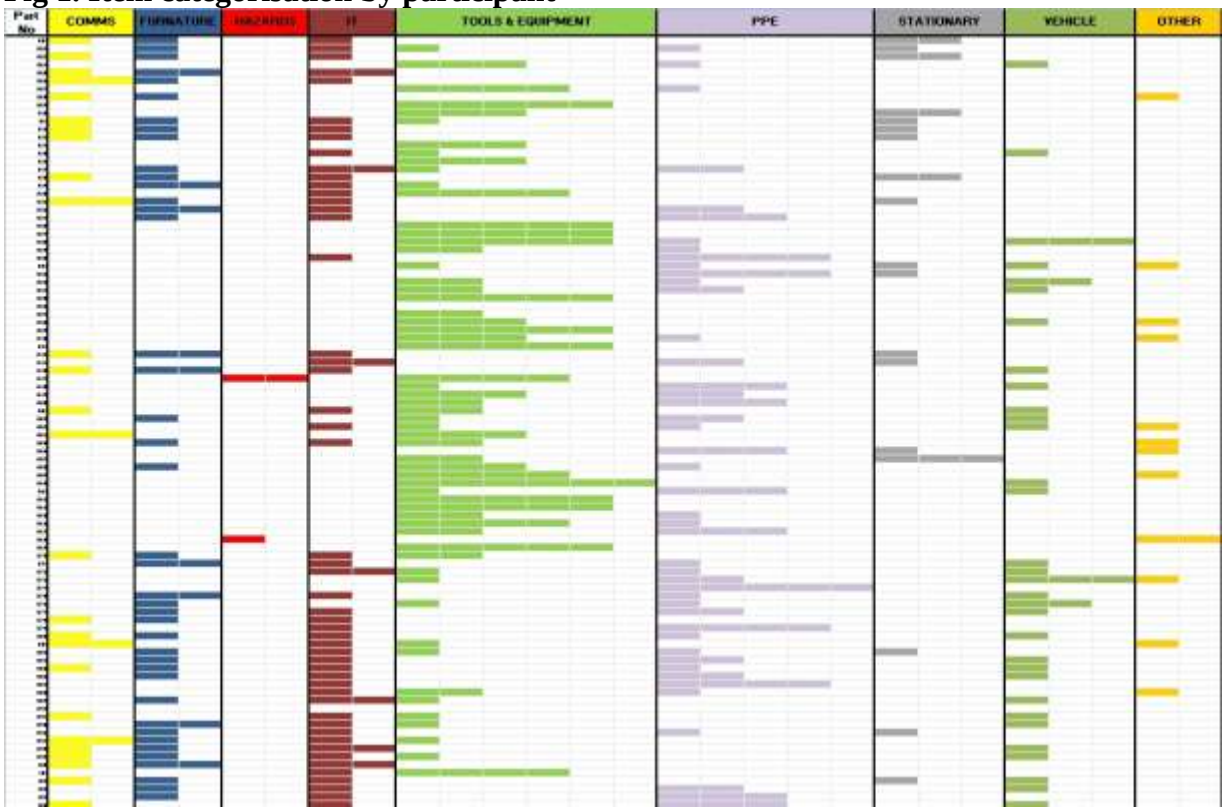
Table 3. Respondents were asked to describe the equipment they use to perform the main duties of their job. This has been divided into 9 main categories (*n*=659);

Category	Example of equipment	*n*	Frequency (%)
Communications	Mobile and fixed phones, two-way radio	31	7
Furniture	Chairs, desks	50	11
Hazards	Chemicals	3	1
IT	Desktop and laptop computers, VDUs	58	13
Work tools and equipment	Screwdrivers, shovels, photocopiers, water lance	151	33
PPE	Boots, glasses, hardhats, high-visibility jackets	88	19
Stationary	Calculator, pen, paper	24	5
Vehicles	Car, forklift, mobile plant	38	8
Other/ unknown		13	3

50% (*n*=76) of the 'work tools and equipment' (n=151) mentioned were identified as 'hand-tools', which included items such as; hammers, spirit-levels and trowels, some people mentioned using more than one of item of "tools and equipment" to perform their job task. The remaining 'tools and equipment' were made up of larger items such as; shovels , and lifting equipment, such as sack trucks, as well as office items such as photocopiers. Figure 1 also shows that 25 people who indicated using items from the "work tools and equipment" category also used PPE. There was no significance in this relationship when Pearson Chi-Square and Cramer's V tests were run. However, there was a statistically significant

relationship where $p \leq 0.000$ for the Pearson Chi-Square and Cramer's V between people who indicated using "IT" equipment and "furniture".

Fig 1. Item categorisation by participant



It is also important to understand people's interaction with their WEE. Respondents were asked to indicate the frequency they perform different activities on a scale of "often, sometimes, rarely or never" for sitting, standing or lifting heavy equipment. 12.5% (n=12) of participants performed all three activities frequently. This would suggest these respondents were often active at work. 63% (n=60) of respondents indicated they were "often or sometimes" lifting or handling heavy equipment, this would seem representative of the worker sample at the construction company. 8% (n=6) of respondents said that they "rarely" sat at work and 6% (n=6) indicated that they never sat at work.

The environment that people work in was also important to consider, and respondents indicated that they generally were working "inside a building or enclosed structure". However, almost the same amount of people, 45% (n=43), also described working "outdoors/no shelter" at some point during that day (Table 3).

When investigating WEE design there were also other, less tangible, influences on work ability. Included were statements relating to; temperature, lighting, noise, air quality, exposure to harmful substances and the effect other people had on individuals and their work ability (Huizenga et al. 2006, Smith, Wellens 2007). When asked about lighting at work, the majority (88% n=82) agreed that they were provided with sufficient lighting in their work area to enable them to do their jobs and move around safely. 79% (n=70) agreed that they would be provided with local lighting, if asked for.

Many of the items of "tools and equipment" spoken about in the interviews produce noise, which can be intermittent noise made by hammers through to continuous noise produced by

electric drills and saws. 51% (*n*=48) of respondents said that they worked in an environment where the background noise disturbed their concentration and a significant proportion (16% *n*=15), agreed that their work tasks left them with ringing in their ears or a temporary feeling of deafness. The majority of respondents (54% *n*=51) also indicated that their job exposed them to breathing fumes, dust or other potentially harmful substances. Due to the nature of work performed within the construction industry and specifically work performed on site it was not unexpected that respondents indicated working in areas where they felt there were increased noise and lower air quality than in other industrial sectors. On the building site the construction requires the use of concrete, cement and mortar, which contain potentially harmful substances, to fabricate the buildings 28% (*n*=27) of participants said that they "often or sometimes" were required to handle or touch potentially harmful substances or materials. This construction company has a 'gloves on' policy on site and provides different gloves to workers depending on their tasks. The gloves are intended to prevent minor cuts and scratches as well as to protect workers' hands from chemical contact.

The NMQ, used in this study, has been similarly employed to assess the prevalence of self reported musculoskeletal 'troubles' in other research (Gyi, Porter 1998 Williams et al. 2011). Musculoskeletal 'troubles' are referred to in this paper as 'symptoms' and have been defined as; aches, pain, discomfort, numbness or tingling (Kuorinka et al. 1987). Musculoskeletal symptoms are reported in all nine of the body areas identified in the NMQ (Table 4). The severity of the effect of the symptoms was also consistent for most of the body areas. The lower back had the highest frequency for period (the last 12 months) (44% *n*=42) and knees for point (the last seven days) (24% *n*=23) prevalence of MSD symptoms. Period prevalence data was 33% (*n=32*) for the knees, 29% (*n=28*) for ankles and feet and for both the neck and the wrists it was 28% (*n=27*). When asked if they felt their symptoms were actively related to their work, again there was a high response rate for all nine body areas, apart from elbows, attributing the disorder to their job demands. Identifying these symptoms can also facilitate understanding their causes and thus lead to more successful prevention of injury and illness developed through them.

Table 4. Reported musculoskeletal symptoms for period and point prevalence, impact of symptoms on normal activities and attribution to work activities (*n*=96)

Body Area	Period prevalence (12 months) % (*n*)	Point prevalence (7 days) % (*n*)	Severity [a] (12 months) % (*n*)	Is this trouble actively related to your work? % (*n*)
Neck	28 (27)	10 (10)	7 (7)	16 (15)
Shoulders	26 (25)	11 (11)	6 (6)	18 (17)
Elbows	18 (17)	7 (7)	0 (0)	0 (0)
Wrists/hands	28 (27)	17 (16)	7 (7)	17 (16)
Middle back	22 (21)	10 (10)	6 (6)	19 (18)
Lower back	44 (42)	21 (20)	17 (16)	31 (30)
Hips/thighs or buttocks	19 (18)	13 (12)	5 (5)	11 (11)
Knees	33 (32)	24 (23)	7 (7)	15 (14)
Ankles/feet	29 (28)	18 (17)	10 (10)	21 (20)

[a] Reported impact on normal activities

Discussion

When considering ageing in the workplace it is important to understand what the workplace is made up of. For construction workers, the workplace is a fast changing environment (Gibb et al, 2006) for several reasons this can be due to the weather or indeed that the building project is progressing so the physical work environment has to change rapidly to accommodate this. Also the length of time people have been working at a company might have an effect on their work environment as different companies can work to different guidelines. Generally, at this construction company, people had worked for the company longer than they had been in their current job roles.

66% (n=63) indicated that they had experienced some form of musculoskeletal symptom in the last 12 months. Of these, 70% (n=19) had also experienced symptoms in the same body areas in the past seven days. The area of the body with the highest period prevalence was the lower back 44% (n=42) this is the same result as for people involved in heavy manufacturing work (Williams et al. 2011)). The NMQ was not used to act as clinical diagnosis of the working population, but to provide an overview of the workers self-reported symptoms in relation to their WEE design (Kuorinka et al. 1987, Williams et al. 2011).

On most UK construction sites certain PPE must be worn by all workers and visitors who wish to go out 'on site'. In the UK there is some variety in the different items that are required, with head protection being the most likely and gloves or light eye protection being the least likely. It can be seen in Figure 1 that of the 48% (n=45) of people who indicated wearing PPE, 55% (n=25) also indicated using an item from the "tools and equipment. During the site visits it was clear, on all occasions, that all persons "on site" were wearing PPE, this included a minimum of; helmets, jackets and safety boots. However, for the questionnaire survey, not all people who would be expected to use PPE mentioned it as part of their five pieces of equipment used to perform job tasks. During interviews it was noted that PPE was worn when performing job tasks but it was not reported as being an item used to perform and complete job tasks in the way other items were, such as trowels or screwdrivers. Considering all of the reported items of "tools and equipment", (n=151) only 5% could be directly attributed to office equipment the remainder appeared to be items that would commonly be used for the construction of buildings.

The use of these items might be contributing factors to the musculoskeletal symptoms experienced by workers at this company. Many interview participants indicated travelling on site by foot, climbing up temporary, mobile and fixed stairwells, as well as working in confined spaces, all of these activities can have an effect on the lower back. However, many respondents of the questionnaire also indicated that they "often or sometimes" were involved in the lifting or carrying of heavy equipment.

There is evidence in the literature that a perception of ageing is that as a person gets older their ability, mental and physical, reduces (Buckle et al. 2007). This perception of ageing was reflected in the five work related statements which shows a statistically significant difference between age groups ($p \leq 0.05$), people aged ≥50 were in stronger agreement ($> p \leq 0.01$). Similar findings to this were evident in a case study company involving heavy manufacturing (Williams et al. 2011). During the interviews participants indicated that they felt some job tasks would get harder to do as they got older, these were generally concerns with the physical side of their jobs, especially the moving around on site between locations. Weather was also said to affect their ability to work and was said to contribute to increased awareness of musculoskeletal symptoms.

Unfortunately, one of the limitations of the research in this paper was the sample size of 96 respondents. The results presented and discussed in this paper are only concerned with one construction company therefore there are limitations in the ability to transfer the results to other working populations. However, a previous case study of cement workers has provided some parallel in the results. These workers were involved in heavy manufacture and future research might look in more detail to investigate more similarities between the workers and the results in greater transferability between the results. Also only ~12.5% (n=12) of the surveys returned were completed by women, causing a bias towards men, however, this does represent the working population at this construction site.

Conclusion

Age can have effect on people's perceptions of work ability and it was evidenced that, with age, respondents thought that work ability reduced. However, there is no evidence to say that this is indeed the case. However, along with other work (Cook et al, 2010), the study does suggest that people working in construction are prone to experiencing musculoskeletal symptoms. These may affect their work ability and some respondents said they felt that their symptoms were directly as a result of their work. Effects of their workplace environment and equipment on their symptoms could be due to the 'nature' of the job, i.e. working outside in all weathers. Cold weather was said to increase awareness of musculoskeletal symptoms and wet working environments were attributed to causing difficult working conditions.

Symptoms were also experienced in the knees, ankles and feet. This could be potentially attributed to the footfall travel on site as described in the interviews. Many of the respondents were involved job tasks that involved them "lifting or handling heavy equipment" this too could have an impact on their musculoskeletal health.

It can be concluded from the results presented in this paper that workplace environment and equipment can influence work ability within the construction industry. Due to the dynamic nature of the work it can be difficult to predict the working conditions of employees as there are many external influences on this, the weather being one and the changing shape of the building or structure being worked on another. As such, it is essential to inform and educate people so that they may be empowered to work in ways that best benefit their health and by doing so reduce the likelihood of injury or ill health through work activities. By employing user-centred design techniques it is hoped that the most appropriate information can be provided by and to construction worker cohorts. The other benefit from this research is that if it is possible to identity good, healthy and practical practice and to disseminate this knowledge across the industry and amongst other, similar, job rolls then perhaps the young today will not experience work-related ill heath tomorrow.

This paper presents and discusses the findings from one case study company. Other companies participating in the research will benefit from the findings drawn from this case study and this company from the findings from the other case studies. Future studies with all companies will involve in-depth research capturing user-centred design ideas and solutions to facilitate healthy working into later life. Due to the sample size it was not possible determine any statistical difference between persons $\leq$50 years or $\geq$50 years in relation to musculoskeletal symptoms, this will be investigated when larger data samples are combined. The results from this company and the other case study companies will be shared amongst

relevant parties and results will be disseminated to larger audiences where there are there are overlaps in job types, work tasks as well as internally within own industries.

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