BUILDING HEALTHY CONSTRUCTION WORKERS BY BETTER WORKPLACE DESIGN: UNDERSTANDING THE CONTEXT

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Changing demographics and pension policies are reflected in the increasing age of workforces in the UK. Older workers are seen to be experienced, dedicated and reliable but also as being slower and tiring more easily. Staying fit and healthy for work is a key concern, particularly in the construction industry, where tasks are often challenging and adverse conditions prevail. Despite it being accepted that injury and ill health go hand in hand in the construction industry, older employees are still keen to work. The ageing workforce creates a demand for research which promotes productivity, workability and quality of life. Workplace design and ergonomics can have a substantial influence on working practices and an individual's ability to undertake aspects of their work, and research has shown that workers can successfully contribute to this. This research is therefore investigating the role of older experienced workers in healthy design in the construction workplace. It is hypothesised that healthy behaviours can be facilitated by good design and also by utilizing the experiences of older workers. Participatory ergonomics is key in this research; previous findings have evidenced the advantages of including workers, as they are the experts in their field. Older workers in particular will be included as a result of their extensive experience within the construction industry. This paper will present the rationale and context for a PhD study investigating ageing workers within the construction industry funded by Age UK.

Keywords: ageing, ergonomics, health, workers, workplace design.

INTRODUCTION

We are currently living amongst an ageing population, where it is predicted that within the next 50 years there will be double the number of pensioners (Frommert et al 2009). This shift in demographics is also being seen within the workplace, and construction in particular; since 1990 there has been an annual increase of 2% of workers aged over 40 (Cook et al 2009). The construction industry is heavily relied upon throughout the world for both economic and employment output (Helander 1991), but it is well known for being a tough, heavy manual and physically demanding industry. Many workers are suffering with musculoskeletal disorders, aches and pains, and in severe cases, disabilities which are forcing them to leave work early; 63% of all retirements within the construction industry are due to medical conditions (Arndt et al 1996). Gubéran and Usel (1998) claimed that on average there were no more than

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50% of construction workers reaching the age of 65 being able to continue working. This is causing construction to lose experienced workers which may also be having a negative effect on the industry in light of the recent abolishment of the retirement age (BBC 2011).

The setup of construction projects - such as the layout of workspaces and introduction of new interventions - is difficult to alter, particularly due to the constantly evolving nature of construction sites. This research hopes to exploit the knowledge and experience of older workers, to encourage better design of the workplace and facilitate healthy behaviours. It is anticipated that these changes will enable workers to remain in the construction industry for longer, reducing the number of workers being forced into early retirement.

BACKGROUND TO THE RESEARCH

"Construction has one of the worst records of industrial safety" (Dester and Blockley 1995). Construction work involves a great deal of manual labour, heavy lifting and working in awkward positions for long periods of time; workers are often required to work at extreme heights, occasionally in bad weather and in dusty, noisy environments (Albers et al 1997; Lemasters et al 2006). The nature of construction work can naturally lead to issues with health later in life; musculoskeletal disorders are a common problem seen in construction workers, along with diseases such as dermatitis, a condition which makes skin sore and cracked, caused by the handling of cement and plaster for long periods of time (Cook et al 2009). These health issues can be exacerbated by the natural decline in physical abilities as workers age; muscle strength and stamina decrease and injuries take longer to recover from (Larsson, Grimby & Karlsson 1979; Lemasters et al 2006; Chau et al 2004). Although there is research worldwide into work and ageing, there is a lack of research into the roles that older workers take on in the construction industry as a result of their ageing and physical decline. This could be for a number of reasons, although the most likely is that many older workers are unable to continue in the industry and are forced to take early retirement (Gubéran and Usel 1998).

A small minority of older workers are able to take on more supervisory roles with decreased exposure to manual work and may also move onto training young apprentices in the industry (Gosling et al 2012). Older workers are considered to be reliable, produce work of a high quality and be experienced in their trade, however they are also perceived to be slower and less receptive to changes in the workplace (Dainty, Ison & Briscoe 2005; Leaviss et al 2008). The perception of older workers being slow outweighs any other positive perceptions, due to the nature of construction work being heavily reliant on high productivity for financial gain (Leaviss et al 2008). Previous research has suggested that older workers wish to remain in the workplace but that they have reported a dislike of power tools, preferring to use tools of a higher quality design due to the way in which they learnt the trade during their apprenticeships (Leaviss et al 2008). Older workers have also reported significantly more complaints in relation to their work, such as finding it more physically and mentally demanding, feeling tired and having complaints related to their vision, and upper and lower extremities (de Zwart et al 1999).

These findings support the premise that it is essential for the workplace to be designed in a way which accommodates changes in older workers to ensure they are able to remain in the workforce for as long as they wish. It is not only the workplace which can and should be adapted; behaviour based safety management, job rotation and

micro breaks have also been suggested as interventions in the industry (Lingard & Rowlinson 1997; Leaviss et al 2008; Albers et al 2005). Changes have been made in previous research however these are rarely as a direct result of adapting to the changes in older workers. Several studies have investigated the development and success of interventions; however the main reasons for these interventions are often of financial interest, or in an attempt to increase productivity (van der Molen, Bulthuis and van Duivenbooden 1998; de Jong, Vink and de Kroon 2003; de Jong and Vink 2002). Changes that have been made include modifications to tool design, new prototype tools such as a pneumatic powered wall lift for plasterers and extended windows in crane cabins to reduce the need for operators to be bending forwards to see to ground level (Li 2002; de Jong and Vink 2002; Mirka et al 2003; Ringen et al 1995).

Many of these studies did not involve the workers who would have been using the interventions; discussions were commonly led by management staff and project leaders, often with minimal input from ergonomic experts or manual workers. These previous studies, although successful in their implementation of interventions and prototypes are arguably missing the central point; it is the workers who hold the most in-depth knowledge of their trades, therefore it should be the workers who are consulted regarding their health and the methods used to protect it to prolong their work ability. Vink, Urlings and van der Molen (1997) conducted an intervention with 50 scaffolders using a participatory approach. They involved the scaffolders in each stage of the process and several modifications were made as a result of this, including the development of a special pallet truck, alterations to the planning of work and the introduction of shoulder protection in clothing. This approach meant that the interventions were relevant and specific to the workers' needs and this was supported by 60% of the scaffolders reporting that they felt they had enough influence in the study. This study reiterates the importance of input from the end users and emphasises their ability to reflect upon their requirements for healthy working. This project, funded by Age UK hopes to harness this experience and knowledge of older workers and use this to facilitate healthier design in the workplace.

PROJECT AIMS

This research is part of a bigger PhD project exploring construction workplace opportunities and barriers which can facilitate healthy ageing at work and healthy behaviours by design. The aims of this project are:

- To understand healthy ageing through design in the construction industry
- To capture workers' knowledge and experiences of 'healthy' design in the workplace

RESEARCH METHODOLOGY

A sample of 60-80 construction workers will be recruited from 2-3 large companies through personal and professional contacts in discussions with line and site managers. Although the focus is on ageing, workers of a range of ages from trades such as electricians, plasterers, bricklayers and joiners will be involved in order to investigate any differences in opinions or ideas between ages and trades. Inclusion criteria consists of trades which require physically demanding tasks such as being in awkward or cramped positions for long periods of time or having to perform repetitive awkward movements throughout the working day. Due to the peripatetic nature of construction sites, the sample of workers will be stratified by age (under 25, 25-34, 35-49, 50+) and a range of trades will be interviewed due to the variety of tasks within each trade.

This research will incorporate Reason's (1994) 'co-operative inquiry', which acknowledges and includes the contribution from the workers on the construction site; an integral component of participatory ergonomics. Participatory ergonomics is key within this research; although a relatively new concept, it has been used for over 60 years (Coch and French 1948). In order for the design of the workplace to be improved successfully, it is essential that the users of that workplace are involved. Participatory ergonomics has been proven to be effective in increasing productivity, motivation and success of implemented interventions (Vink, Urlings and van der Molen 1997; Hess et al 2004; Loch et al 2010). It has been shown that interventions suggested by workers themselves are more likely to be used within the workplace, such as shoulder support for scaffolders and a fold out bench device within work vans (de Jong and Vink 2002). During a trial of a production line made up of older workers, employees of a BMW factory were encouraged to put forward design ideas to increase workability and worker motivation (Loch et al 2010). This resulted in a production increase of 7% and an increase in participation throughout the trial period. Design ideas implemented included new flooring to reduce impact, which was causing discomfort, and new chairs to enable employees to have a relaxing break in between shifts. This trial worked so well because workers felt that their opinions and ideas were valued and given serious consideration; when suggested ideas such as the change in flooring became a reality, one worker reported that this showed them the project could make sense.

In this research, construction workers will be engaged in order to harness their experience and knowledge of the industry; their awareness and experiences of issues relating to the design of the workplace and healthy working behaviours will be investigated using semi-structured interviews. Semi-structured interviews have been shown to be successful in allowing the participants to speak of their own experiences in a relaxed environment, whilst allowing the interviewer to cover any topics of interest that are not naturally raised within the conversation (Leaviss, et al 2008; Choudhry and Fang 2008). The interviews will be conducted on site and will consist of four key sections, as shown in Table 1.

Demographic data will be collected to stratify the age and trade of the participant as well as their tenure of employment. Age is stratified as: under 25, 25-34, 35-49 and 50+. Participants will then be asked to describe their everyday working tasks, allowing the interviewer to gain a better understanding of their job. This also gives workers an opportunity to discuss the risks involved in their work and tasks that they find particularly strenuous, dangerous or demanding.

Regarding ideas and current changes, participants will be asked if they have ever altered or modified their workplace/tools to make their job easier, or if they have any ideas about how to do this. If the worker has no ideas, this is also documented. Participants will be asked about any advice they would give to a younger worker, or if they were ever given any advice about how to do their job. Trade specific questions are also asked where appropriate, such as electricians coping with poor lighting and bricklayers working outside. If changes have been made, further questioning includes who is responsible for instigating and maintaining these changes.

Following the open-ended questions, quantitative data will be collected using 3 questionnaires. The Stage of Change questionnaire, developed by Prochaska and DiClemente (1983) and adapted by Whysall et al (2007) for the reduction of work-related musculoskeletal disorders, utilises a 5-point scale to ascertain behaviour

related to the participant's 'readiness to change'. Workers are asked if they think change is necessary and if so, how urgently these need to be made to establish how they feel about themselves and their job. The answers from the participant translate onto the scale, putting them in one of 5 stages; pre-contemplation, contemplation, determination, action, maintenance or relapse. If an individual is in the "contemplation" stage they are more likely to consider design ideas and changes in the workplace and are thus in turn more likely to provide suggestions and solutions to problems. However if a worker is in the "pre contemplation" stage it is likely that they will have never considered the design of the workplace and feel it is acceptable how it is, suggesting they are less likely to be open to the concept of change and less likely to put forward any ideas for the design of their workplace. Secondly the Nordic Musculoskeletal Questionnaire (Kuorinka et al 1987) establishes the location and severity of any musculoskeletal symptoms participants may have suffered with. These are measured both as a 12 month period prevalence and a 7 day point prevalence alongside establishing the severity of the symptoms over the past 12 months. The questionnaire also allows the participant to consider whether these disorders have developed as a direct result of their work. The Work Ability Index (Ilmarinen et al 1991; Liira et al 2000) determines how able the participants feel to continue working as well as investigating the demands of their job. Participants are presented with a 10 point scale to rate their work ability from 0 (completely unable to work) to 10 (the best they have ever worked). This quantitative data is collected at the end of the interview to ensure that musculoskeletal disorders are not the focus of the participant, they are also used to validate any issues that may have arisen within the interviews.

Table 1: A summary of questions and issues discussed during interviews

	Questions and issues
Demographics	Age range. Occupation. Time spent in employment
Their Job	Everyday tasks? Tools and equipment used? PPE requirements and usage? Location of job? Awkward/cramped positions? Use of chemicals? Is there dust, noise?
Ideas & Current Changes	What ideas do you have to make your job easier? To make the workplace better? New/different equipment? Flooring, lighting, PPE, talks, workshops, job rotation, micro-breaks, better facilities? What advice would you give to a younger worker? What would you do differently? E.g. Plasterer- how do you cope with the weight of the trowel and wet plaster? Electricians- what do you do about extra lighting in smaller areas? Bricklayers- what issues do you face with working outside? Weather?
	What is being done right now to make your job easier? Who comes up with these changes? Who is responsible for implementing and maintaining these changes? Are you using different equipment? Altering current equipment? Order of jobs? Wearing knee pads / particular gloves / other clothing modification?
Health (Quantitative)	Stage of Change questionnaire (Prochaska and DiClemente 1983) Nordic Musculoskeletal Questionnaire (Kuorinka et al 1987) Work Ability Index (Ilmarinen et al 1991)

As this is a semi-structured interview, the researcher is at liberty to adjust questions or change the order or language of the interview; this is hugely advantageous considering the subjective nature of the topics being discussed. Construction, whilst being relatively uniform in its output, can consist of numerous methods and techniques, often unique to individuals and their trades. The semi-structured nature of the interview allows the participants to discuss their own personal experiences of their

work, and their own unique ideas and opinions on what they think constitutes 'good and healthy design' in the workplace. This also allows them to freely discuss any changes they have made, or would like to make in the workplace to improve their health and workability.

To triangulate data and investigate and evidence issues raised in interviews, observations will be conducted in the field where possible. This could consist of participants showing the researcher a particularly demanding task, awkward posture, or modification to their environment to make their job easier. Videos and photographs will be taken to supplement interview recordings. Observations will occur in the event of workers being unable to take time out to take part in an interview. This may be due to the nature of the work and the fact that many participants could be on 'price work' i.e. they are paid more money if they are more productive and finish either on or before the estimated deadline.

LIMITATIONS

There are limitations involved in the collection of this data. As previously mentioned, many construction workers may be working 'on price' therefore recruiting participants who are willing to take time out of their work to be interviewed may prove difficult. Building sites are peripatetic in nature, they are constantly evolving and changing; there are very few areas on building sites which are able to provide a quiet environment suitable for recording audible interviews. Notes can be taken by the researcher however this does not provide the richness and depth of coverage in comparison to an audio recording. The nature of this research is not only subjective as previously discussed, but also retrospective; workers will be asked about how their job has affected their health and also whether they have ever modified their environment (or wanted to) as a result of wanting to protect their health. Asking about modifications to the environment can be a very context-specific question, causing the workers to agree that yes, they have wanted to make changes at times, but they may experience difficulty when recalling what changes were needed, or why. Not only this, but any changes workers make are highly likely to be subconscious therefore it is anticipated that workers may struggle to think 'on the spot' of design ideas. This is an issue which will be emphasised if the worker has stepped away from their work station in order to take part in the interview. A solution to this context-specific limitation could be to interview participants in their workspace, however the nature of the data collection would require the worker to step away from their work at times in order to complete questionnaires. This would also make recording the interview inherently more difficult due to the high noise levels on construction sites and the dark, dusty environments. The "healthy worker effect" is a recognised phenomenon presenting an important limitation in this research (Svendsen et al 2004; Shephard 1999). This occurs when older workers appear to be healthy with high work ability because they are present at work; those who are suffering with musculoskeletal disorders, skin disorders, injuries and so on, are unlikely to be present at work and are therefore unable to be included in the sample. This limitation will be overcome by endeavouring to interview participants from a retired construction workers union further into the project.

CONCLUSIONS

Construction work is a tough, physically demanding job leaving many employees unable to continue in their work. Many older workers wish to remain in work, but the industry makes this difficult to do. Workers within the construction industry have a

wealth of experience and knowledge about their jobs, and this can be used to the advantage of future workers and their employers. A methodology is presented in order to harness the knowledge and experience of these workers so that the design of the workplace can be altered in order to encourage healthy working behaviours, thus increasing the work ability of older construction workers.

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REFERENCES

Albers, J, Estill, C and MacDonald, L (2005) Identification of ergonomics interventions used to reduce musculoskeletal loading for building installation tasks. "Applied Ergonomics", 36, 427-439.

Albers, J, Li, Y, Lemasters, G, Sprague, S, Stinson, R and Bhattacharya, A (1997) An Ergonomic Education and Evaluation Program for Apprentice Carpenters. "American Journal of Industrial Medicine", 32, 641 - 646.

Arndt, V, Rothenbacher, D, Brenner, H, Fraisse, E, Zschenderlein, B, Daniel, U, Schuberth, S and Fliedner, T M (1996) Older workers in the construction industry: results of a routine health examination and a five year follow up. "Occupational and Environmental Medicine", 53, 686-691.

BBC (2011) Compulsory retirement age at 65 fully abolished. Available from http://www.bbc.co.uk/news/business-15127835 (accessed 20th February 2013).

Coch, L and French, J (1948) Overcoming resistance to change. "Human Relations", 1(4), 512-532.

Chau, N, Gauchard, G C, Siegfried, C, Benamghar, L, Dangelzer, J, Français, M, Jacquin, R, Sourdot, A, Perrin, P P and Mur, J (2004) Relationships of job, age, and life conditions with the causes and severity of occupational injuries in construction workers. "International Archive of Occupational and Environmental Health", 77, 60-66.

Choudhry, R and Fang, D (2008) Why operatives engage in unsafe work behavior: Investigating factors on construction sites. "Safety Science", 46, 566-584.

Cook, S, Richardson, J, Gibb, A G F and Bust, P D (2009) Raising awareness of the occupational health of older construction workers. In: RMIT, cib W099 International Conference "Health and Well-being stream", 2009, Melbourne Australia. RMIT, ISBN 978-1-921426-47-6, 33-43.

Dainty, A R J, Ison, S G and Briscoe, G H (2005) The construction labour market skills crisis: the perspective of small-medium-sized firms. "Construction Management and Economics", 23, 387-398.

Dester, W and Blockley, D (1995) Safety - behaviour and culture in construction. "Engineering, Construction and Architectural Management", 2(1), 17-26.

Frommert, D, Hofäcker, D, Heien, T and Andreß, H J (2009) Pension systems and the challenge of population ageing: what does the public think? In: R. Edmondson and H. von Kondratowitz, (eds.) "Valuing Older People: A Humanist Approach to Ageing". Bristol: The Policy Press.

Gosling, E Y, Gyi, D E, Gibb, A and Haslam, R (2012) Ageing Productively through Design: A Survey of Cement Manufacturing Workers. "Aging and Society", 1, 1-23.

Gubéran, E and Usel, M (1998) Permanent work incapacity, mortality and survival without work incapacity among occupations and social classes: a cohort study of ageing men in Geneva. "International Journal of Epidemiology", 27, 1026-1032.

Helander, M (1991) Safety hazards and motivation for safe work in the construction industry. "International Journal of Industrial Ergonomics", 8, 205-223.

Hess, J, Hecker, S, Weinstein, M and Lunger, M (2004) A participatory ergonomics intervention to reduce risk factors for low-back disorders in concrete laborers. "Applied Ergonomics", 35, 427-441.

Ilmarinen, J, Tuomi, K, Eskelinen, L, Nygard, C, Huuhtanen, P and Klockars, M (1991) Summary and recommendations of a project involving cross-sectional and follow-up studies on the aging workers in Finnish municipal occupations (1981-1985). "Scandinavian Journal of Work and Environmental Health", 17, 135-141.

de Jong, A and Vink, P (2002) Participatory ergonomics applied in installation work. "Applied Ergonomics", 33, 439-448.

de Jong, A, Vink, P and de Kroon, J (2003) Reasons for adopting technological innovations reducing physical workload in bricklaying. "Ergonomics", 46(11), 1091-1108.

Kuorinka, I, Jonsson, B, Kilbom, A, Vinterberg, H, Biering-Sorensen, F, Andersson, G and Jorgensen, K (1987) Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. "Applied Ergonomics", 18(3), 233-237.

Larsson, L, Grimby, G and Karlsson, J (1979) Muscle strength and speed of movement in relation to age and muscle morphology. "Journal of Applied Physiology", 46, 451-456.

Leaviss, J, Gibb, A and Bust, P (2008) Strategic Promotion of Ageing Research Capacity Understanding the Older Worker in Construction. Available from http://www.sparc.ac.uk/media/downloads/executivesummaries/exec_summary_gibb.pdf (accessed 10th December 2012).

LeMasters, G, Bhattacharya, A, Borton, E and Mayfield, L (2006) Functional Impairment and Quality of Life in Retired Workers of the Construction Trades. "Experimental Aging Research", 32(2), 227-242.

Li, K W (2002) Ergonomic design and evaluation of wire-tying hand tools. "International Journal of Industrial Ergonomics", 30, 149-161.

Liira, J, Matikainen, E, Leino-Arjas, P, Malmivaara, A, Mutanen, P, Rytkönen, H and Juntunen, J (2000) Work ability of middle-aged Finnish construction workers – a follow-up study in 1991-1995. "International Journal of Industrial Ergonomics", 25, 477-481.

Lingard, H and Rowlinson S (1997) Behavior-Based Safety Management in Hong Kong's Construction Industry. "Journal of Safety Research", 28(4), 243-256.

Loch, C, Sting, F, Bauer, N and Mauermann, H (2010) How BMW is defusing the demographic time bomb. "Harvard Business Review", 88, 99-102.

Mirka, G, Monroe, M, Nay, T, Lipscomb, H and Kelaher, D (2003) Ergonomic interventions for the reduction of low back stress in framing carpenters in the home building industry. "International Journal of Industrial Ergonomics", 31, 397-409.

van der Molen, H F, Bulthuis, B M and van Duivenbooden, J C (1998) A prevention strategy for reducing gypsum bricklayers' physical workload and increasing productivity. "International Journal of Industrial Ergonomics", 21, 59-68.

Prochaska, J and DiClemente, C (1983) Stages and processes of self-change of smoking: toward an integrative model of change. “Journal of Consulting and Clinical Psychology”, 51, 390-395.

Reason, P (1994) Three approaches to participative inquiry. In: N.K. Denzin and Y.S. Lincoln (eds.) "Handbook of Qualitative Research". California: Sage Publications.

Ringen, K and Seegal, J (1995) Safety and health in the construction industry. “Annual Review of Public Health", 16, 165-188.

Shephard, R (1999) Age and Physical Work Capacity. "Experimental Aging Research: An International Journal Devoted to the Scientific Study of the Aging Process", 25(4), 331-343.

Svendsen, S W, Bonde, J P, Mathiassen, S E, Stengaard-Pedersen, K and Frich, L H (2004) Work related shoulder disorders: quantitative exposure-response relations with reference to arm posture. "Occupational and Environmental Medicine", 61, 844-853.

Vink, P, Urlings, J and van der Molen, H (1997) A participatory ergonomics approach to redesign work of scaffolders. "Safety Science", 26(1), 75-85.

de Zwart, B, Frings-Dresen, M and van Duivenbooden, J (1999) Senior Workers in the Dutch Construction Industry: A Search for Age-Related Work and Health Issues. “Experimental Aging Research", 25(4), 385-391.