Building and maintaining healthy construction workers for longer working lives through better workplace design

Building and maintaining healthy construction workers for longer working lives through better workplace design

by

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Doctoral thesis submitted in partial fulfilment of the requirement for the award of Doctor of Philosophy of Loughborough University

CERTIFICATE OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this thesis, that the original work is my own except as specified in acknowledgments or in footnotes, and that neither the thesis nor the original work contained therein has been submitted to this or any other institution for a degree.

……………………………………………. (Signed)

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Abstract

Globally, there is an ageing population resulting in an older workforce; in the UK it is predicted that by 2050 over one third of the workforce will be aged over 50. Construction involves heavy manual labour where working into later life may be difficult and natural, age-related decline is exacerbated by working conditions. Co-developing ideas with workers using participatory approaches can facilitate positive, healthy change in the workplace. The aim of this thesis is to explore ways in which construction workers' jobs and workplaces can be made healthier, easier and safer to facilitate healthy ageing and longer working lives.

An in-depth interview study with 80 construction workers explored their understanding of their health and wellbeing at work and ideas for improvement. The Nordic Musculoskeletal Questionnaire identified a high prevalence of symptoms in workers of all ages in the knees, lower back, wrists and hands. Many of these symptoms were considered to be work related; interestingly, this did not affect Work Ability Index ratings. Workers had good ideas to improve their health and wellbeing at work; over 400 changes had been made or were being sustained by workers around improving manual handling, PPE, tools and machinery and health and wellbeing. A further 265 new suggestions were made concerned with education and supervision, facilities and human resources.

In-depth focus groups with senior stakeholders (*n*=18) in three construction organisations explored barriers and opportunities for change. They were concerned about the health and wellbeing of their workers; were keen to hear their ideas; and identified poor communication within the whole workforce as a barrier to change. Opportunities to improve the situation included better feedback to workers, and interactive toolbox talks to encourage idea generation and sharing experiences.

Finally, participatory workshops with senior stakeholders and trades' workers (*n=23*) captured ideas for the development of a resource for the industry to facilitate longer working lives. Participants strongly suggested that the resource should facilitate communication between the workforce and supervisors by being visually engaging, strongly health-related and interactive, to capture and maintain the attention and involvement of the workforce.

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Publications

Journals

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Other

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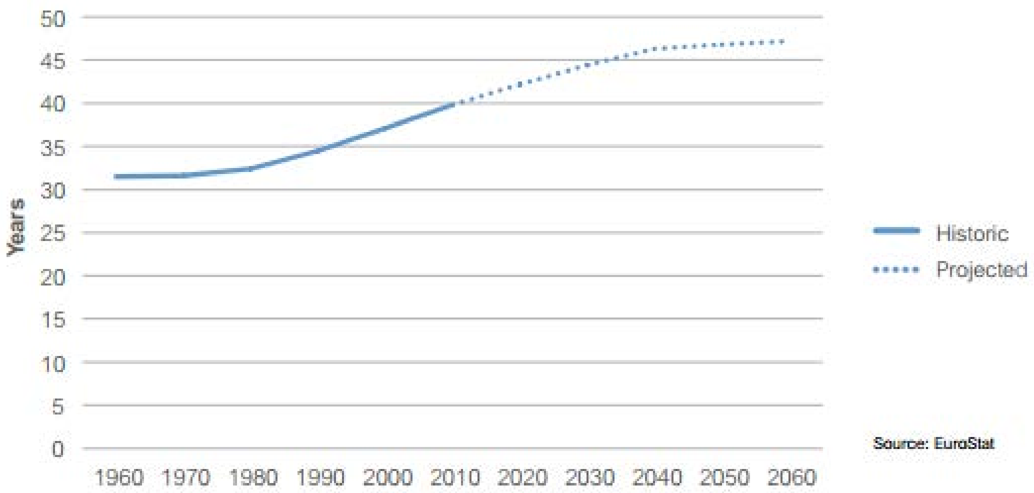
1. Introduction

1.1 Background to research

Globally we are experiencing an ageing population due to a decline in birth rates together with healthy life expectancy as we live longer lives. Worldwide, the number of people aged over 60 increased from 9.2% in 1990 to 11.7% in 2013 and is predicted to increase to 21.1% (over 2 billion) by 2050 (Sander et al., 2015). In addition to this increase, worldwide life expectancy has also risen from 65.3 years in 1990 to 71.5 years in 2013 (Murray et al., 2015). As shown in Figure 1, the median age in Europe is predicted to rise above 45 by the year 2060 (Creighton, 2014). Despite the increase in life expectancy, there is no simultaneous increase in quality of life; the prevalence of age-related disorders such as Alzheimer's and cardiovascular disease remain high (Murray et al., 2015; Sander et al., 2015) and from a review of literature exploring the effects of ageing, Crawford et al., (2010) found increased incidences of diabetes and arthritis for people aged under 65 but less deaths from coronary heart disease, stroke and cancer for those aged over 65. Between 2010 and 2050 the proportion of older people (aged over 65) is projected to rise across the world; Western Europe has one of the oldest populations, with the share of people aged 65 and over expected to increase from 17% in 2010 to 30% by 2060 (Walker & Maltby, 2012).

Figure 1: Predicted increase of median age in Europe *(EuroStat in Creighton, 2014)*



With an ageing population comes an ageing workforce; in developed countries in 2005, the youngest proportion of the working population (15-29 years old) was almost equal to that of the oldest proportion (50-64 years old), however by 2050 it is predicted that almost a third of the workforce will be aged 50 and over (Vos et al., 2008; EU-OSHA, 2014). In the UK, this may be due to the change in legislation deeming it illegal to discriminate against workers due to their age, meaning that employees cannot be forced into retirement (Equality Act, 2006). It is also likely to be due to the abolishment of the official UK retirement age (GOV UK, 2014) allowing employees longer working lives if they so wish, together with the UK state pension age being increased to 67 in 2014 (Pensions Act, 2014). In light of an ageing workforce, it is essential that workplaces are designed so that all workers can age healthily and remain in work for as long as they can, or for as long as they wish.

It is well documented that as we age, mental and physical capacities decline. For example the lens of the eye becomes stiffer (a condition known as presbyopia), affecting vision at both long and short distances; hearing declines particularly at the speech frequencies, making conversations difficult; and muscle strength, stamina and lung capacity decrease which can cause difficulty during physical exercise and strenuous activity. However, it is important to acknowledge that not every individual will experience age-related declines at the same rate, due to variations caused by a number of intrinsic and extrinsic factors such as genetics, lifestyle factors and occupation (Saxon et al., 2010) in addition to this, people's perceptions of their own age also varies (Truxillo et al., 2012).

Older workers may encounter difficulties particularly in occupations which require manual work such as construction, which is well known for being a tough, heavy industry to work in. Heavy lifting, twisting and turning, being in awkward and cramped positions for long periods of time, and performing repetitive movements are commonplace in this working environment. In addition, workers are often required to work in damp, dark environments sometimes with little natural light or ventilation. These conditions can be difficult for workers of all ages, however for older construction workers these environments can exacerbate the effects of naturally occurring age-related declines. For example, reduced visual ability can mean that older construction workers may not detect hazards in the work environment and a decrease in muscle strength and stamina can make manual tasks such as heavy lifting more difficult.

Older construction workers are valued in the industry and they are considered to be experienced, dedicated, good at their job and produce work of a high quality and many want to stay in their jobs for longer (Leaviss et al., 2008a). In this interview study by Leaviss et al., (2008a), younger construction workers talked about having a lot of respect for older workers and the value of apprenticeships with older construction workers as mentors had also not gone unnoticed by workers the industry. However, there were also negative perceptions such as older workers being slow, not open to using new tools or technology, being opposed to health and safety rules and being difficult to train. Despite the latter, older construction workers actually have fewer injuries compared to younger construction workers; Lipscomb et al., (2010) found a 5-fold higher incidence rate of emergency department treated injuries in workers aged 16-19 in comparison to workers over the age of 55. However, when older workers do sustain injuries, they are often more severe and take longer to recover from in comparison to younger workers. Older workers are also at a higher risk of slips, trips, stumbles and falls in the construction workplace (Kemmlert & Lundholm, 2001).

There is therefore a need for more research on how jobs and workplaces can be designed to accommodate older workers to ensure ‘healthy ageing’ and a good quality of longer working life. In the context of the proposed research, ‘healthy ageing’ is considered to be a concept where good working practices and ergonomic workplace and job design are encouraged to reduce the risk of injury and ill health in workers of all ages. Healthy ageing can be encouraged by ensuring workers take care of their bodies in their trades and are aware of their health and wellbeing at work.

In terms of definitions of ‘workplace design’ there are a wide range of descriptions although there is very little consensus in the literature. Buckle et al., (2008) considered it to include aspects such as the culture of the organisation, requirements of tasks, the surrounding physical environment, its layout and the equipment within it and Joroff et al., (2003) consider the design of the workplace to be an integral part of the relationship between work, the workplace and the tools of work. Another term, ‘job design’ is more specifically defined in the literature; Holman et al., (2012) define it as “the mechanisms through which job characteristics affect employee outcomes such as performance and wellbeing” and Truxillo et al., (2012) claim that it ‘relates to job satisfaction and task performance’. Within the context of this research, ‘workplace design’ is not confined to physical design, but all aspects that can affect ones’ ability to work such as the culture of the workforce and ‘job design’ is considered to encompass all aspects that workers have control over, such as the way they carry out their work tasks and the order in which they complete them.

Previous research studies have successfully used participatory ergonomics approaches to improve workplace or job design by involving the end-user in all stages of development and intervention (Hignett et al., 2005). Wilson (1995a) consulted the users of a crane control room to significantly improve the workplace design such as seating, lighting and control panels and Hess et al., (2004) worked with concrete labourers to modify the use of ‘skid plates’ during manual labour which significantly reduced lower back loads. This bottom-up approach together with good management support to encourage workers to propose ideas can lead to significant benefits to workplace design and behaviours and therefore has the potential to facilitate longer, healthier working lives as well as encouraging productivity and engagement.

1.2 Aims and objectives

Previous research has suggested that older construction workers find working in their trades difficult as they age, however they are still considered to be an asset to the workforce due to their extensive knowledge and experience. The aim of the research presented in this thesis is to explore ways in which construction workers’ jobs and workplaces can be made healthier, easier and safer to facilitate healthy ageing and longer working lives. The findings will contribute to recommendations and guidance for the construction industry to engage the workforce and encourage idea generation to facilitate healthy working practices. They will also contribute to the development of an impact resource for Age UK for dissemination to the construction industry.

This research is sponsored by Age UK's 'Research into Ageing Fund'. The proposal specified that the research should:

> *"Investigate the role of older, experienced workers in healthy design in the construction workplace. The belief is that the industry can learn from these workers in terms of facilitating healthy behaviours by good design"*

Based on this, the objectives of the research are:

1. To critically analyse the literature in construction research related to older workers, health and wellbeing, and ageing.
2. To explore the methodologies appropriate for the study of health, wellbeing and ageing in construction workers.
3. To explore what construction workers understand about their health and wellbeing in their trades and capture ideas they have to make their jobs and workplaces safer, healthier, easier and more comfortable.
4. To explore the opportunities and barriers to change with senior stakeholders in the industry.
5. To capture ideas for the development of an impact resource from trades' workers and senior stakeholders to facilitate healthy working behaviours.
6. To provide guidance to the construction industry to engage their workforce, facilitate idea generation and encourage trades' workers to consider their health, wellbeing and ageing at work.

1.3 Methodology

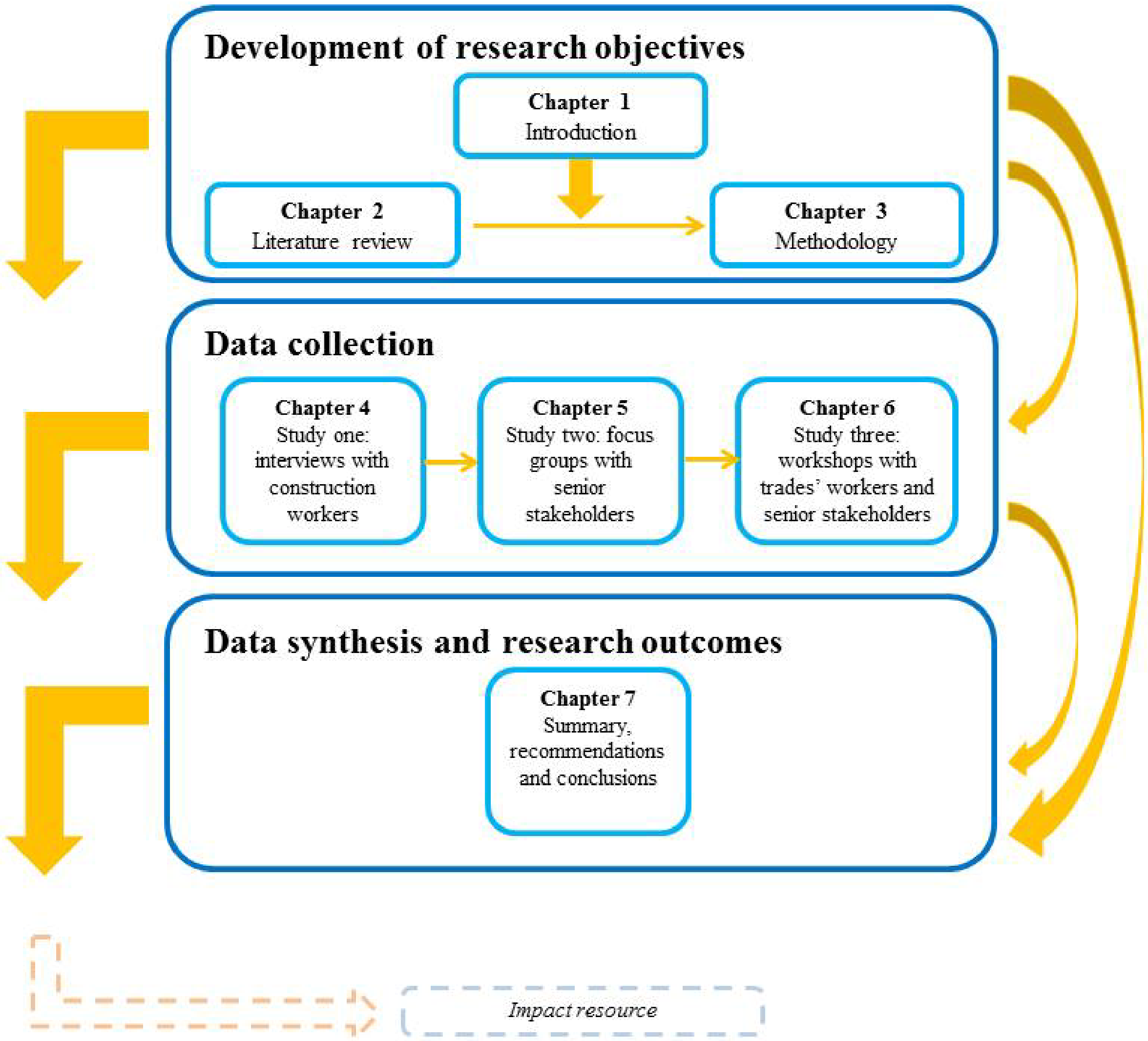
A critical analysis of previous literature was conducted in order to review and identify gaps in the research in areas such as ageing, the older worker, the construction industry and its workers and the older construction worker (Objective 1). Methodological approaches were then reviewed in order to understand the most appropriate for the study of construction workers and their health and wellbeing at work (Objective 2). **Study One** used in-depth, semi-structured interviews with 80 construction workers to explore what they understood about their health and wellbeing at work and to capture any ideas they had to improve their jobs or workplaces. Quantitative data on the prevalence of musculoskeletal symptoms was collected using the Nordic Musculoskeletal Questionnaire (Kuorinka et al., 1987; Gyi et al., 2013) and self-rated perceptions of work ability were collected using the Work Ability Index (Ilmarinen & Rantanen, 1999) (Objective 3). **Study Two** involved focus groups with senior stakeholders in the construction industry (*n=18*) to explore their perceptions of older construction workers, and the opportunities and barriers to change in the workplace (Objective 4). **Study Three** involved workshops with both trades' workers and senior stakeholders (*n=23*) to inform the development of an impact resource for the construction industry; the most appropriate type of resource, how it could be implemented and who it should be tailored to (Objective 5).

The findings of these studies will be presented in this thesis which will conclude with a summary and recommendations for various stakeholders in the construction industry in addition to future work and research (Objective 6). These recommendations will aim to encourage healthy working behaviours and enable construction trades' workers to remain in work for as long as they feel able to or as long as they wish.

1.4 Structure of the thesis

The thesis is structured as shown in Figure 2. **Chapter 2** and **Chapter 3** present a review of the literature and methodologies respectively, which are appropriate for achieving the research objectives. **Chapter 4** presents the methodology and findings of Study One: interviews with construction workers. **Chapter 5** presents the methodology and findings of Study Two: focus groups with senior stakeholders. **Chapter 6** presents the methodology and findings of Study Three: building the healthy construction worker workshops. **Chapter 7** summarises the findings of the research including recommendations and conclusions for the construction industry to encourage healthy working behaviours. Recommendations for the development of an impact resource for dissemination to the construction industry are also included in this chapter.

Figure 2: Overview of thesis



2. Literature review

The literature review has been divided into two chapters; the first (Chapter 2) reviews the literature in relation to ageing, the older worker, health, safety and wellbeing and the older construction worker. The second (Chapter 3) reviews methodological approaches which are appropriate to studying workers in the construction industry.

The objectives of this chapter are:

1. To understand current knowledge about the ageing process and ageing at work particularly in the construction industry.
2. To identify and critically discuss the current gaps in the literature related to the research.

A search strategy involving journals and databases with specific search criteria was employed. Google Scholar was the primary source of journal papers, in addition to Loughborough University's Catalogue Plus which allowed for specific searches of databases such as PubMed, ARCOM (Association of Researchers in Construction Management) and Science Direct. The reference lists of useful papers were also used in order to 'snowball' the literature search. The initial relevance of papers was determined via the title, keywords and abstracts. Exclusion criteria for paper selection included non-English papers, sources such as blogs and magazines and where the content of the paper was judged to be not relevant. Several different search terms were used to gather a wide range of literature to be reviewed (Table 1 and Appendix A3). The range of search terms meant that several thousand results were provided for each search; the first 100 papers of each search were reviewed, if papers were still being found to be relevant after this point, the researcher continued through the search results.

A systematic approach was taken to reviewing the literature; relevant research papers were reviewed using Pluye's Mixed Methods Appraisal Tool (MMAT) (Pluye et al., 2011). This appraisal tool allowed for critical analysis of qualitative, quantitative or mixed methods research studies and provided criteria for scoring the research study from one to five based on the written style i.e. "Are there clear qualitative and quantitative research questions or objectives?" and "Do the collected data address the research question?". The MMAT has been critically appraised as a tool, based on critical examination of 17 health-related systematic studies (Pluye et al., 2011). Using this method took approximately 15 minutes to appraise each research paper. For the full MMAT please see Appendices A1 and A2. Table 1 presents an example of the search strategy used for the literature review and Table 2 shows a selection of the key words. For further detail on the search strategy and full list of key search terms please see Appendices A3 and A4 respectively.

Table 1: Example of search strategy used for literature review

Database searched	Search term Used	Number of papers found	Number of papers reviewed
ARCOM	"ageing" or "aging"	19	3
ScienceDirect	"construction worker"	143,124	34
PubMed	"older construction worker"	21	19

Table 2: Example of search terms used for literature review

Search terms used	
Ageing	Aging
Older worker*	Construction
Construction worker*	Construction industry
Health	Wellbeing
Disease*	Musculoskeletal
Work ability	Older construction worker*

**including the pluralism of the term*

2.1 Ageing

Ageing is defined as;

> *"The progressive degradation of biological function over time that results from an accumulation of biological damage that eventually exceeds the repair capacities of the body"*
>
> (Nakasato & Carnes, 2007)

Many believe old age to be synonymous with retirement at 65, with "very old age" being 80 and above (Molenbroek et al., 2011), however with the recent abolishment in the UK of an official retirement age and the state pension age being increased to

67 in 2014 in the UK, there may be further confusion as to when “old age” begins. Throughout our lives there are convenient milestones to identify the stage of life we are in, whether by level of education (pre-school, secondary school, college, University) or physiological characteristics (birth, puberty, adulthood) however there is not such a definitive stage to identify “old age” (Roebuck, 1979). As a result of this, research into ageing is wide-spread, with little uniformity regarding the age of participants used.

An ageing population is being seen in the UK, Europe and globally, particularly in developing countries; Eastern Europe, Japan and some Western European countries are experiencing population decline, resulting in a rapidly ageing demographic (Ezeh et al., 2012). This is attributed to a decrease in reproductive rates and an increased life expectancy; by 2046 the mean life expectancy in Europe is predicted to increase to 84.5 years for men and 89 years for women (Rechel et al., 2013). Japan and France have the highest life expectancies for both men and women in addition to Canada for women and Australia for men (Jacobzone, 2000). Western Europe has one of the oldest populations, with 17% aged over 65 in 2010 which is predicted to increase to 30% by 2060 (Walker & Maltby, 2012).

2.1.2 The effects of ageing

The effects of ageing on the body are well known and well documented, however it is extremely important to remember that people will age at different rates depending on individual circumstances and characteristics (Fozard et al., 1994; de Zwart et al., 1995; Truxillo et al., 2012). This variability between individuals means that often research findings related to ageing cannot be generalised to further populations. Lifestyle and diet are thought to play a significant part in how we will age later in life including concerns about cancer, cholesterol and heart problems (Fozard, 2000). The way in which we age can be dependent on both intrinsic and extrinsic factors; intrinsic factors are those defined by individual genes, such as our gender, hormonal balance and physical characteristics. Extrinsic factors are those we have more control over, such as our diet, medications and exposure to the environment such as sun rays and radiations (Saxon et al., 2010). Occupations and the work tasks undertaken by an individual can also have a profound effect on the ageing process.

Some aspects of ageing such as cognitive changes are outside the scope of this thesis but Table 3 contains an overview of the effects of ageing relevant to this research. The following sections provide an overview of these changes.

Table 3: Age related changes to the body

Senses	Changes
* Vision	Presbyopia – inability to focus
	Yellowing of the lens
	Loss of eyelid elasticity
** Hearing	Presbycusis – loss of hearing
*** Touch	Sensitivity to tactile stimuli declines
∆ Smell	Decline in sense of smell
∆ Taste	Decline in sense of taste
∆∆ Skin	Loses elasticity
	Becomes thinner and more prone to tears
	Becomes drier and rougher
∆∆ Bone	New bone formation decreases leading to lower bone mass and weaker bones which are more prone to fractures
◊ Muscles	Isometric and dynamic strength decrease
	Joint complaints become more frequent
	Increase in morning stiffness in joints
	Cartilage in joints becomes rougher and less cushioned, resulting in bone rubbing on bone
*** Respiratory	Lungs become stiff and capacity decreases
∆∆ Cardiovascular	Heart needs longer to recover from each beat
∆∆ Immune system	Immune system decreases
	Common infections are more severe and take longer to recover from
⌂ Cognitive	Cognitive tasks become longer and more difficult to complete
	Integrity of the brain decreases – reaction times fall due to slower decision making in the brain

*Glasser & Campbell, 1998; Pokorny et al., 1987 ** McMahan & Chikamoto, 2006. *** Cook et al., 2009
∆ Schiffman, 1997 ∆ ∆ Saxon et al., 2010 ◊ Byström et al., 1991 ⌂ Fozard, 2000

2.1.2.1 Vision

As we age our visual abilities naturally decline, often as a result of changes to the lens of the eye and ciliary muscles. Accommodation is the procedure which allows us to focus on objects near to and far from us. Accommodation becomes more difficult and eventually impossible with age, a condition called presbyopia, which occurs when the lens becomes harder and less able to change shape. In a study of 20 subjects age 15 to 55, using continuous ultrasonographic biometry, it was found that the ability to accommodate decreases dramatically with increasing age and that the accommodation process also becomes significantly slower (Beers & van der Heijde, 1996). These findings are supported by Glasser & Campbell (1998) who found similar age related changes in eyes from organ donors. The use of these two different methods which yield similar results suggests a strong reliability for the onset and increased prevalence of presbyopia with increasing age.

Other factors also affecting vision are the absorption of light into the lens, which causes it to appear more yellow (Pokorny et al., 1987). This usually occurs from around the age of 50 and results in the information reaching the retina being of a reduced quality (Steenbekkers & Beijsterveldt, 1998). The yellowing of the lens significantly affects around 20% of people aged 80 or older which has also been shown to affect people's ability to differentiate between colours (Ishihara et al., 2001).

2.1.2.2 Hearing

In 2010, 156, 600 people were registered as 'hard of hearing' in England; 69% of these people were aged 75 and over (National Health Service, 2010). As we age, the sensory organs within the inner ear begin to degenerate in a process known as presbycusis; this decreases hearing ability and is caused mainly by structural changes and damage to the cochlea (Steenbekkers & Beijsterveldt, 1998). In a sample of 813 males aged 20-95, a steady increase in hearing loss was found when asking participants if they could detect an audible tone particularly at high and speech frequencies, with increasing age (Brant & Fozard, 1990). This was a large sample across a broad age range, increasing the reliability of the results. Hearing ability can also decrease as a result of the hardening of the wax within the ears, which becomes more likely with age (Saxon et al., 2010).

2.1.2.3 Skin and bone

The skin is the largest, most visible and complicated of the body systems and uses one third of the blood circulating in the body (Saxon et al., 2010). As we age our skin becomes thinner and loses elasticity; the decrease in elasticity and collagen means that the skin is less able to retain moisture, causing it to become dry and cracked (Rao, 2007). Xerosis is a condition which occurs when the sweat glands in the epidermis of the skin change and allow more fluid to escape, resulting in dry and rough skin with a scaly appearance, mainly found on the exposed areas of skin such as the hands and forearms (Luggen, 2008).

As we age, the balance between bone resorption and new bone formation becomes unbalanced, until bone resorption exceeds new bone formation. This leads to lower bone mass and weaker bones which become more prone to fractures (Saxon et al., 2010). Peak bone mass is reached by the age of 30, after this bone marrow becomes more porous which can result in osteoporosis (Marenberg, 2007).

2.1.2.4 Muscles and joints

According to Larsson et al., (1979) isometric and dynamic strength increase until 30 years old, remain constant throughout the 40s and start to decrease from 50 onwards. This is supported by Frontera et al., (1991) who used an isokinetic dynamometer to find that subjects aged 78 had significantly lower strength in all their muscles in comparison to subjects aged 45. According to Coni et al., (1984) with increasing age we lose lean body mass including the mass of our brain, heart, lungs, kidney, liver and all of our muscles and bones. This is supported by Pendergast et al., (1993) who claim that in order for people to do activities of daily living at the age of 70, they need an additional 40% of the muscle strength that they had at age 20. Grandjean (1976) found that movement in the arms and legs becomes restricted due to a reduction in the elasticity of bodily tissues. Alongside muscle strength, grip strength also declines with age; in a sample of 347 subjects over 73, it was found that hand grip strength deteriorated significantly for both men and women when tested using a specially designed strain-gauged dynamometer over a period of 8 years while also finding that muscle strength deteriorated quicker in women than in men (Bassey, 1998). The longitudinal nature of this study provides a high level of validity, although the decrease in grip strength cannot be attributed to one singular cause. Occupation can also have an effect on strength; among 388 men aged between 31 and 75, young manual workers had the highest muscle strength however older manual workers had the lowest muscle strength in comparison to white collar workers, suggesting that heavy manual labour for a long period of time can exacerbate the natural decline seen in ageing (Era et al., 1992). Crawford et al., (2010) conducted a review of the health and safety of older workers and found that physical strength and endurance are specific to the individual based on their day to day physical activities.

Joint complaints also become more recurrent in later life, possibly as a consequence of the cartilage in the joints becoming rougher and less cushioned, resulting in bone rubbing on bone and causing pain (Saxon et al., 2010). A large study by Badley and Tennant (1992) found that out of 42,826 people, only 5% of those aged between 16 to 24 compared to 54% aged 85 and older reported joint problems, with the back and knees being the most frequently reported sites. This increase in joint problems with age was accompanied by an increase in reported morning stiffness of more than half an hour (Badley & Tennant, 1992).

2.2 The older worker

As previously discussed, the global population is ageing which is contributing to an increasingly ageing workforce. With the abolishment of an official retirement age and the UK state pension age being raised to 67 in 2014, employment policies are changing their focus from incentives for early retirement to now encouraging longer working lives. A critical analysis of research papers related to older workers was conducted using Pluye's MMAT (Pluye et al., 2011) and can be found in Appendix A5; this shows an example of the papers most relevant to this topic which scored an appraisal of 2* or above. A score of 2* using Pluye's MMAT means that the quality of the research paper is 50% therefore any papers scoring lower than this were considered too low quality to be included.

Previous research has suggested that remaining in work for longer can have a positive effect on individuals' health and wellbeing, not least because the transition from working life to retirement can be a stressful time. Remaining in work can maintain cognitive functioning in addition to a number of benefits such as providing a sense of purpose and also remaining financially stable for a longer period of time.

Park and Reuter-Lorenz (2009) proposed the 'Scaffolding Theory of Aging and Cognition' which suggests that age-related declines can be countered by engaging in cognitively stimulating tasks and exercise, such as those required in many occupations. This theory has been supported by several research studies such as

Crawford et al., (2010) who conducted an in-depth review into the health and safety needs of older workers and found that age-related changes in cognitive function can be moderated by increased intellectual activity. Similarly, Rohwedder & Willis (2010) conducted a cross-national study of older people in the US, England and 11 European countries and discovered a causal relationship between early retirement and a significant reduction in the cognitive abilities of individuals in their early 60s such as memory. The cross-national sample in this study demonstrates that despite potential cultural differences within jobs, early retirement can have negative effects on an individual's cognitive ability. These findings were supported by a longitudinal study of ten years by Wickrama et al., (2013); a large, nationally representative sample of 8,524 workers over the age of 62 were found to be experiencing a decrease in both work status and working memory with increasing age. These results were found to be interchangeable, with immediate memory having an effect on work status and vice versa, suggesting that a higher work status, with inevitably more challenging cognitive work, can have a positive effect on working memory. It was also found that individuals who remained in work for longer, performed better on a simple memory task and that those with better memory were more likely to maintain a full or part time job. Due to the longitudinal nature of this study, these findings are considerably valid and reliable. The nationally representative sample obtained from the Health and Retirement Study (Health and Retirement Study, 1992) means that the findings could be generalised to further older populations. In support of these findings, research has suggested that individuals aged 60 and over who remain in paid work have less functional impairment than those who are no longer in work (Hinterlong et al., 2007).

Reasons for remaining in work are not just related to physiological and cognitive functioning; Desmette and Gaillard (2008) found that workers were more likely to remain in work if they associated being an 'older worker' with being valued for their experience in the workplace; in contrast to this, if individuals felt they were being unwillingly classified as 'older workers' this was a contributing factor to early exit from the labour force. However, these findings cannot be generalized to the wider population due to the large variance in employment policies across the UK and globally and the way in which organizations treat their employees, particularly older workers.

Despite numerous studies suggesting that remaining in work has positive implications, it is important to consider the population available for study; the "healthy worker effect" can mean that studies investigating the health and wellbeing of workers provide only a sample of the individuals who feel fit and able to work. Those who are unable to work will inevitably not be present in the sample population therefore risking a biased set of results (Dement et al., 2009). In addition to this, there have been very few causal links identified; a number of factors have the potential to affect an individual's ability and desire to remain in work such as degenerative diseases, marital status and home-life including parent-child relationships; it has become increasingly common for older workers to leave the labour force early to help with the care of their elderly parents or grandchildren (Martinengo et al., 2010; Wickrama et al., 2013).

In addition to research suggesting the health benefits of remaining in work there are also studies demonstrating the disadvantages of retirement. Buxton et al., (2005) found that early retirement can lead to an increase in health complaints as well as neurotic disorders. When assessing 1,875 participants aged between 50 and 64 it was found that 70% of early male retirees reported at least one health complaint in comparison to 55% of men who were still in the labour force and 22.2% of early retirees reported prevalence of a neurotic disorder in comparison to 8.2% who were still in work. These results however, were self-reported which may present some bias and were collected via questionnaire and not followed up by interviews or corroboration from health practitioners. An important limitation to this study was that participants' reasons for retirement were not explored, meaning that the higher prevalence of mental and physical health complaints may be related to the decision to take early retirement. The sample used in this study came from the Psychiatric Morbidity Survey of Great Britain and as a result the findings cannot be generalised to different populations due to the difference in working cultures in other countries. In support of this, Alavinia and Burdorf (2008) studied over 11,000 participants across Europe aged between 50 and 65 and found a huge variance across countries for example, 42% of men in Austria in this age group were in paid employment compared to 75% in Sweden. 18% of employed workers reported ill health compared to 37% in retirees. However, 39% of unemployed participants also reported this which suggests that it may not be retirement itself which can contribute to ill health but the lack of a job.

Whilst working into later life has been shown to have multiple benefits in addition to the concerns over early retirement, there are also many research studies counteracting this view and suggesting that retirement can lead to an improvement in health. Westerlund et al., (2009) found that workers who self-rated their health as 'suboptimum' during the seven years prior to their retirement experienced an increase in perceived health immediately after retirement. These findings come from a reliable, longitudinal study with a consistent sample of occupational French males with self-rated perceptions of health also being compared to assessments of physical illnesses to corroborate findings. However, these findings may have been affected by the working conditions of the participants, where poor or stressful working conditions would inevitably cause a decrease in perceived health prior to retirement. Using the same sample from the 'GAZEL' cohort, which was established in 1989 with employees of a French national gas and electricity company, Westerlund et al., (2010) found that retirement was also associated with decreased prevalence of mental fatigue, physical fatigue and depressive symptoms. However, none of these research studies took a home-work life balance into consideration or the actions taken by participants after retirement. For example, it is common for older people to take on other duties such as caring for grandchildren or voluntary or part-time work, which may either positively or negatively affect the prevalence of fatigue subsequent to retirement depending on the characteristics of the individual. Crawford (2005) identified a number of barriers for the employment of older workers, including caring responsibilities, benefit disincentives and a lack of confidence in the ability to find work.

There may also be additional concerns for older workers remaining in their occupations, considering the multiple age-related declines in physiological functioning occurring in ageing individuals. For example, a decrease in visual acuity and balance can lead to an increased risk of slips, trips and falls in older workers (Deacon et al., 2005; Leaviss et al., 2008b) and a decrease in cardiovascular output and muscle strength can make manual tasks more difficult to complete in comparison to younger workers (Pendergast et al., 1993). However, despite potential decreases in the cognitive ability of older workers, Brewington & Nassar-McMillan (2000) found this did not affect the quality of their decision making.

As shown, findings relating to working into later life are inconsistent. However, in the context of an ageing population and therefore an ageing workforce, it is essential that workers are enabled to remain in work for as long as they wish. If an individual wishes to remain in their job into later life, it is vital that managers and companies accommodate the needs of their employees. For many years, research into the views and perceptions of older workers has yielded inconsistent findings, with employers in a broad range of industries holding a mixture of both positive and negative opinions related to older workers. Whether or not employers acknowledge holding these perceptions, they can often contribute to age-related discrimination in employment and in the workplace.

In 1994, Taylor and Walker conducted a postal survey of over 300 employers who had a workforce of over 500 people. 43% of these employers stated that age was an 'important consideration' in the recruitment of their staff, with older workers being perceived to have a lack of appropriate skills, but also being loyal, productive and reliable. The quantitative nature of this study meant that these perceptions could not be investigated further by the researchers, leaving the reasons for these opinions unexplored. Surveys could have been followed up using member checking in in-depth interviews which may have provided further data to validate these findings, explain why these perceptions were held and what effect they had on the recruitment process. Nevertheless, this study is still being used in today's research papers as a basis for the mixed perceptions held by employers of older workers. Loretto and White (2006a) built upon these findings more recently by conducting in-depth qualitative focus groups with 40 employers; similar results were found, in that all employers operated an 'equal opportunities policy', but in practice, age bias and discrimination was observed. The use of interviews in this study decreases the potential for bias, as employers were encouraged to elaborate on their views and use of their equal opportunities policy. There were strong similarities between the two research studies in terms of employers' perceptions of older workers, with these employers feeling that older workers had a better temperament, were more flexible with their time and had greater life experience and job knowledge. However, there were also negative opinions that nightshifts were unpopular with older workers and that younger ‘prime-age’ workers were preferred as a general workforce. Using focus groups for interviews may have introduced a potential bias, as participants may have displayed individual characteristics such as some being more vocal than others. In addition, participants were recruited for this study using volunteer sampling, presenting a potential bias in that employers may already feel comfortable and confident in employing older workers. Employers who were perhaps more negatively biased towards an older workforce may have been less inclined to take part in the research.

Historically, both positive and negative perceptions of older workers and an older workforce have remained the same. Older workers are perceived to be dedicated, reliable, good at their job, have more experience, be more tolerant and are more likely to come to work even when they are unwell (Garg, 1991; Ilmarinen & Rantanen, 1999; Brewington & Nassar-McMillan, 2000; Leaviss et al., 2008b). However, negative stereotypes of older workers are that they have a slower performance, decreased ability to learn new skills, are at higher risk of accidents, are opposed to new training and supervision, are more irritable, have poor health and a reduced capacity for manual labour (Garg, 1991; Hansson et al., 2001; Dainty et al., 2005; McMahan & Chikamoto, 2006).

Overall older workers have a high level of skill and dedication that is often not seen in younger workers and this should be exploited by employers, particularly in cases where this knowledge and experience can be passed down to younger employees. Employers seem to be aware of the benefits of older workers however these are overshadowed by the concern of a lack of productivity which translates in to a lack of profit for businesses. Previous research has shown that there are health benefits of working into old age and these could arguably outweigh these disadvantages if employers were aware of each worker’s abilities and were able to tailor their work accordingly. Re-deployment and changing work patterns can be used to improve the productivity of the whole workforce to include older workers and their skills.

2.3 The construction industry

Construction is well known for being a tough, heavy manual industry where workers are often required to work in dark, cold environments; on new builds there is also often very little natural ventilation before windows are installed. It is heavily relied upon by the majority of the world, for both employment and economic output, producing 6-10% of the UK's gross domestic product (Helander, 1991; Jones & Saad, 2003).

> *"The construction industry is often compared to a travelling circus"*
>
> (Koningsveld and van der Molen, 1997)

Many construction workers are required to travel for several hours a day before they reach work (Koningsveld and van der Molen, 1997) meaning long periods of time away from their homes and families (Heller et al., 2007). The nature of the work means the environment is constantly changing, tradesmen are 'constantly working themselves out of a job' and work is never a certainty (Ringen et al., 1995; Everett, 1999). The organization of large construction projects is different to that of other industries making research into construction more difficult; 80-90% of construction firms have less than ten employees, with most workers being self-employed (Ringen et al., 1995). The typical organisation of projects is illustrated by Khalfan & Anumba (2000) in Figure 3 and by Moir & Buchholz (1996) in Figure 4. As these figures illustrate, there is often very little connection or communication between workers and consultants, which can create a stressful environment for both parties.

Figure 3: The typical organisation of construction projects (Khalfan & Anumba, 2000)
**M&E team – Mechanical and Engineering team*

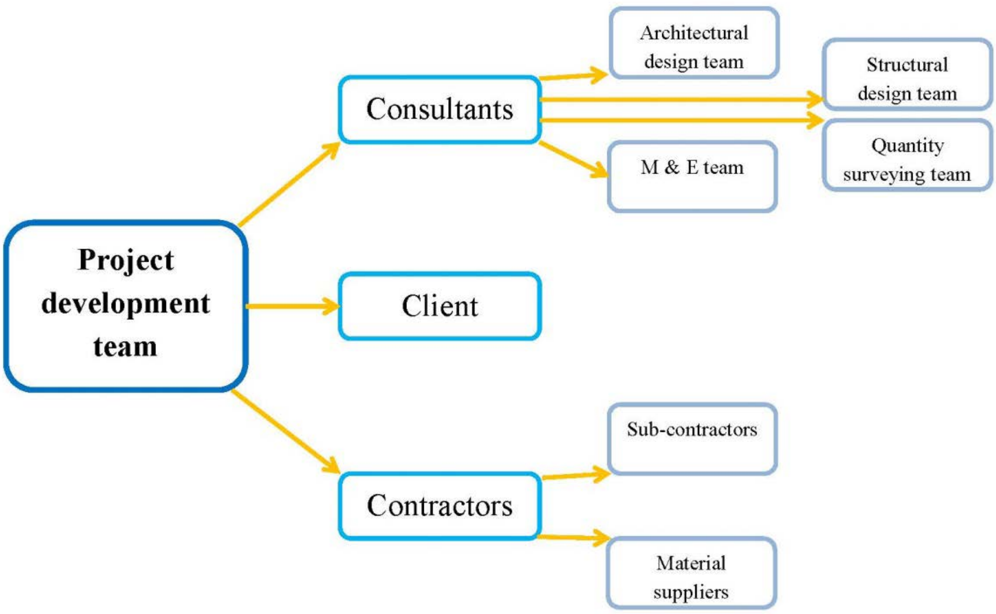
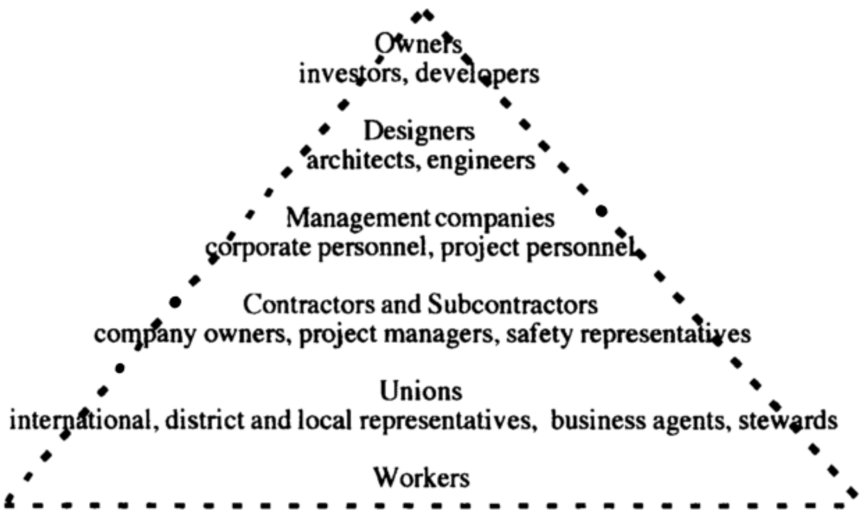


Figure 4: Construction industry hierarchy *(Moir & Buchholz, 1996)*



The construction industry is highly competitive with a strong emphasis on price; contracting companies bid against each other for work which can put immense pressure on the employees to complete jobs within extremely tight margins (Building and Construction ITO, 2013). Much of the industry relies on ‘piece work’ or ‘price work’ which means that trades’ workers receive bonuses for completing jobs within or before a deadline, this also means that often the speed of younger, more agile workers is preferable over the skill and experience of an older worker (Building and Construction ITO, 2013). It has been reported that due to the unreliable nature of construction work and the huge effect of bad weather on the ability to work on sites, in most countries individual construction workers may only work up to 1,500 hours a year in comparison to 2,000 hours in other industries (Ringen et al., 1995). All of these factors can contribute to a high level of stress in construction workers. Not only is there a high risk of stress but there is also a well-documented much higher risk of illness and injury when working in a construction trade. These risks will be discussed in the following three sections; health, safety and wellbeing in construction, injuries and musculoskeletal disorders.

2.3.1 Health, safety and wellbeing in construction

A critical analysis of previous research relating to the health, wellbeing and safety of construction workers was conducted using Pluye’s MMAT (Pluye et al., 2011) and is shown in Appendix A6.

As previously mentioned, the construction industry provides a very different environment for workers in comparison to white collar industries. The tough environment lends itself to a higher prevalence of ill health and injury, meaning that health and safety is well researched within the industry. Statistics from the construction industry have been historically unreliable; workers themselves are responsible for reporting accidents and injuries, meaning that many go un-reported, Ringen et al., (1995) claim that “construction workers disabled or killed each year by work-related illness are believed to be in the tens of thousands but the numbers are anyone’s guess”.

> *“Construction has one of the worst records of industrial safety”*
>
> (Dester & Blockley, 1995)

Construction workers themselves often differ from workers in other industries, with trades workers starting as young as 15, meaning that most individuals spend over 50 years in their trades; workers are exposed to physical manual labour which can contribute to a higher likelihood of musculoskeletal disorders and ill health and can exacerbate the natural age related declines observed in physiological functioning (Hoonakker & van Duivenbooden, 2010).

> *“Construction workers are at greater risk of developing certain health disorders than are the general population and workers in other industries”*
>
> (Brenner & Ahern, 2000)

Construction has a reputation for being a particularly unhealthy industry due to its rates of occupational illness being one of the highest across all occupational groups (Deacon et al., 2005). Cook et al., (2009) conducted research to investigate the types of illness and ill health experienced by construction workers; a literature review and various consultations with health professionals and construction workers suffering with ill health were held to discover a wide range and large number of problems experienced (Table 4). However, capturing sufferers from within the construction industry was difficult due to the specification of illnesses and also the unlikeliness of the individuals being well enough to attend work. Therefore a wider sample was used, of all individuals suffering with specific health problems. This makes the results less valid as the sample used for this study was not representative of the construction population. In addition to this, as a result of the lack of representation, the true causes of these health problems were not investigated fully, meaning that cause and effect could not be inferred. Table 4 summarises a number of health issues experienced by construction workers (Cook et al., 2009).

Table 4: Summary of health issues experienced by construction workers (Cook et al., 2009)

Disorder	Symptoms
Skin disorders	Dermatitis, eczema due to exposure to cementitious products or prolonged contact with water or chemicals
Hand-Arm vibration disorders	Tingling/pins and needles caused by prolonged use of power tools which transmit vibration through the hands and arms
Musculoskeletal disorders (MSDs)	Aches and pains in the upper and lower back, elbows, wrists, neck, knees and ankles. MSDs can cause pain and difficulty with activities of daily living
Noise induced hearing loss (NIHL)	Caused by regular exposure to loud noise
Chronic obstructive pulmonary disorder (COPD)	A tightening of the airways due to particles found in cement dust and other chemicals such as asbestos
Occupational asthma	An allergic reaction to substances in the workplace

Construction workers are frequently exposed to loud noises when using power tools and heavy machinery, which are commonplace on sites. This frequent exposure can cause damage to the ears and in severe cases can cause hearing loss. In a study of 142 workers, 13% reported problems with their ears including infections, perforations to the ear drum and scarring as a result of previous perforations (Deacon et al., 2005). However, there was no evidence to support the suggestion that these health problems were directly related to work as the data were collected via a medical check-up with no questions asked to the participants regarding the cause of these ailments. Often hearing loss can occur gradually due to age and the extent of the damage is not noticed until it is too late. Construction workers can also be exposed to chemicals and dusty working environments which can lead to Chronic Obstructive Pulmonary Disorder (COPD), a leading cause of morbidity and mortality worldwide (Karkhanis & Joshi, 2011). COPD and right heart failure was discovered in a case study of a 75 year old female construction worker. The worker was a non-smoker (smoking is one of the leading causes of COPD), but had been exposed to cement dust for 30 years, the particles of which can cause disease due to its chemical nature (Karkhanis & Joshi, 2011). These findings were supported by Dement et al., (2010), who found that workers who had been exposed to cement dust had a positive association with COPD as well as those who had been exposed to asbestos and silica. Participants from this study underwent a detailed medical analysis and also had their work and exposure history analysed, providing highly reliable findings.

Bricklayers, plasterers and other construction workers who come into frequent contact with water and cementitious products commonly suffer with skin conditions such as eczema and dermatitis. A large number of research studies into skin disorders appear to be from Germany although the reason for this is unclear. Despite the same products being used worldwide, the findings cannot be generalised to other countries due to differences in health and safety practices. There have also been discrepancies in findings, such as a failure to diagnose any cases of dermatitis in construction workers from South Africa (Deacon et al., 2005). There is however, general agreement that properties found in cement such as potassium dichromate and hexavalent chromium can cause negative reactions (Ringen et al., 1995; Bock et al., 2003). Symptoms include redness, cracked skin, itching and bleeding which can cause obvious difficulties and health and safety issues when working on construction sites (Cook et al., 2009). Ringen et al., (1995) claim that the symptoms of dermatitis can be serious enough to cause early retirement.

2.4.2 Injuries

A critical analysis of previous research relating to the prevalence and type of injuries in the construction industry was conducted using Pluye’s MMAT (Pluye et al., 2011) and can be found in Appendix A7.

Helander (1991) believed that construction accidents were much more frequent and serious than accidents in other industries. Chau et al., (2004) studied 880 construction workers in France including masons, carpenters, plumbers and electricians. It was found that the most common injuries were due to the handling or carrying of objects, falls and construction machinery and devices. It is not possible to define causality between the injuries and the tasks being carried out by workers due to the lack of control over extraneous variables. An entirely male sample was used which was largely representative of the construction industry and the indication of specific trades and related injuries allows for more reliable findings which can be generalised across the industry. Masons, plumbers and electricians had more frequent injuries due to moving objects whereas carpenters and roofers had more frequent injuries caused by construction machinery. This may be as a result of carpenters and roofers being outside on site more often than masons, plumbers and electricians who are more likely to be working inside buildings, an aspect which was not qualified within the data collection of this research. Injuries from hand tools were more frequent in younger workers and falls on the same level and to a lower level were more frequent among overweight subjects (Chau et al., 2004).

Falls were also identified as the leading cause of death in a non-European study of over 3,000 deaths and 125,000 injuries in the Korean construction industry over a four year period, suggesting that this is a world-wide risk on construction sites (Jeong, 1998). "Awkward or sudden movements" were also classified as the second most common cause of injuries in construction (16.7%) although this has not been reported in other studies, suggesting a lack of consistency across various construction injury related research. Jeong (1998) also found that the highest number of injuries was seen in workers aged 45 and over which differs from several other studies which have reported younger workers experiencing more injuries (Chau et al., 2004; Schoenfisch et al., 2010) suggesting that there may be cultural differences between construction site safety and injury prevalence meaning that results cannot be generalised further.

Schoenfisch et al., (2010) found that the rate of construction related injuries among 16-19 year olds was almost six times the rate of that for workers over the age of 65 suggesting that a higher level of experience could contribute to a lower prevalence of injuries. This study also found that 54% of injuries were caused by contact with objects or equipment followed by bodily reaction or exertion (19%). However this study did not account for the number nor the cause of injuries that were treated on the construction sites themselves. An older study from Stubbs & Nicholson (1979) found that, of 821 accidents from two large construction companies, 50% of all manual handling accidents were caused by lifting, loading and carrying. With these findings being echoed over 20 years later by Chau et al., (2004) it suggests that similar tasks remain a high risk for construction workers. Everett (1999) supported this by reviewing 65 of the most common building construction tasks; it was found that many were rated as having a moderate or high risk of causing fatigue and/or injury. These findings have been shown to be useful for construction workers and managers who do not have advanced training in occupation ergonomics, but require awareness of how to reduce the risks of injury at work. However, it is essential for both workers and managers alike to be aware of the effect individual differences can have on injury and risk such as general health and wellbeing at work and experience within the job. When nine managers were asked about the cause of accidents in construction, ‘unfamiliarity with the demands of the job’ and ‘poor supervision’ were ranked highest (Gyi et al., 1999). Similarly Falconer and Hoel (1996) interviewed 63 line and senior managers at 8 construction sites, 75% of whom cited carelessness and complacency of the injured party as the main causes of accidents. These studies collected data using qualitative interviews which allowed for rich, in-depth opinions to be elicited. However, on the topic of health and safety on construction sites, managers are unlikely to admit to having a complacent attitude towards health and safety which presents a potential bias in the findings.

2.4.3 Musculoskeletal disorders

Musculoskeletal disorders are the most common non-fatal injury in construction (Deacon et al., 2005). The full table of papers related to this topic which were reviewed using Pluye’s MMAT (Pluye et al., 2011) can be found in Appendix A8.

Historically, musculoskeletal symptoms are one of the most common complaints in construction workers; the majority of construction workers will experience at least one complaint in at least one area of their body each year. Johansson (1994) studied a total of 450 blue and white collar workers across eight large metal industries. It was found that blue collar workers had significantly higher musculoskeletal symptoms in comparison to white collar workers and that they also had significantly higher prevalences of symptoms which were partly or solely related to work. In support of this, Williams et al., (2011) found that out of 96 construction workers, 66% reported having experienced musculoskeletal symptoms in the past 12 months and, out of 292 bricklayers, 67% reported at least one long lasting complaint. These findings have also been echoed across Europe, with 44% of Dutch construction workers reported back complaints, 13% in Ireland reporting musculoskeletal problems and musculoskeletal disorders being the leading cause of disability leading to early retirement in Germany (de Zwart et al., 1999; Brenner & Ahern, 2000; Deacon et al., 2005). These findings are also historically reliable, with research dating back to the early 1980s, suggesting that musculoskeletal disorders are a long-standing issue in the construction industry and a health problem that needs to be addressed in order to improve the working lives of construction workers (Niskanen, 1985). However, many of the findings related to these symptoms are self-reported and very few studies make use of a health physician to confirm the existence of specific problems. In addition to this, much of this research is collected via the Nordic Musculoskeletal Questionnaire (Kuorinka et al., 1987) which does not allow for qualification of the symptoms.

The longer workers spend in the construction industry, the more likely they are to suffer with musculoskeletal disorders (Lemasters et al., 2006; Cook et al., 2009). Particular trades also seem to be at higher risk in certain areas of the body; bricklaying is thought of as one of the more physically demanding trades, with 67% of over 250 bricklayers reporting one or more regular or long-standing musculoskeletal complaint in the previous 6 months (Boschman et al., 2012). Prevalence rates of musculoskeletal disorders in bricklayers range from 50% to 97% with the back, knees and shoulders/upper arms being the highest risk areas (Akinmayowa, 1987; van der Molen et al., 1998; Boschman et al., 2012).

Joiners and carpenters also have high prevalence of back pain which has been attributed to a number of tasks such as sawing wood, erecting roof structures, pushing, twisting and frequent lifting of heavy loads (Luttmann et al., 1991; Latza et al., 2000; Mirka et al., 2003). 24% of over 500 carpenters reported suffering with reduced mobility of the spine and 31% reported suffering pain or tenderness of the spine and surrounding muscles (Arndt et al., 1996). Other musculoskeletal complaints were found in the hands, neck, lower legs/ankles and shoulders including traumatic knee disease (Arndt et al., 1996; Albers et al., 1997; Lipscomb et al., 1997; Punchihewa & Gyi, 2009).

Plasterers have been found to be at a slightly lower risk of musculoskeletal disorders compared to other trades. However they show a six-fold higher rate of disability in comparison to white collar workers (Arndt et al., 1996). Due to the repetitive motion of plastering walls, there is also a high risk of shoulder, back and arm pain (Luttmann et al., 1991; Bongers, 2001; Reid et al., 2001; Leaviss et al., 2008a).

During observations of electricians it was found that up to 10% of work is being carried out over 90° flexion and that the majority of work involves prominent flexion of the head and neck due to the number of overhead tasks (Moriguchi et al., 2013). The nature of this data collection being in the field with natural observations increases the reliability and validity of these findings, compared to other data collected via self-assessed questionnaires in which participants may be inclined to be less honest about their working practices. Although musculoskeletal disorders have been found to be less common in electricians in comparison to other construction trades the areas most at risk are the shoulders and elbows as a result of the amount of overhead work (Cederqvist & Lindberg, 1993; Albers et al., 2005). Due to the repetitive nature of tasks including screwing and fixing with manual hand tools, electricians are also at a high risk of carpal tunnel syndrome (Ringen et al., 1995; Rosecrance et al., 2002).

Back complaints were the most common complaint in many studies (Lipscomb et al., 1997; Widanarko et al., 2011; Boschman et al., 2012). Cook et al., (1996) found that not only were these the most common complaints but that they also accounted for the most lost work time and the most visits to a physician. Inaba & Mirbod (2010) also found that the cold weather exacerbated these symptoms, in addition to symptoms of the fingers, hands and wrists, knee joints, abdomen and foot numbness being more prevalent in winter compared to summer. However, these symptoms were self-reported and also did not account for extraneous variables such as age and location of job, for example, the weather would not affect workers as significantly if they completed the majority of their tasks inside, suggesting that these findings cannot be generalised to other construction workers.

2.4 The older construction worker

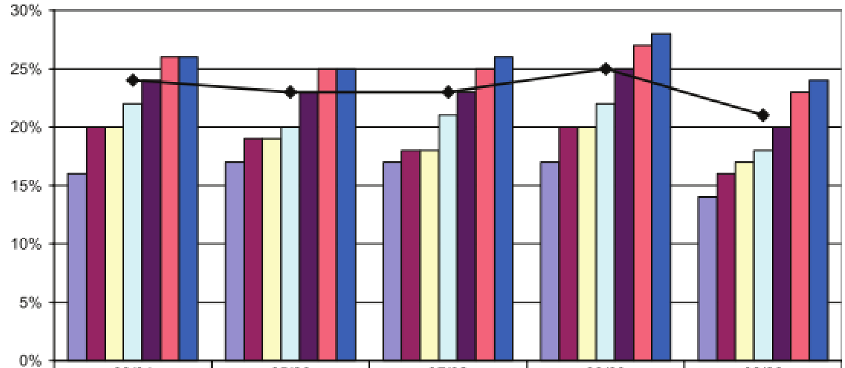
As previously described, ageing at work can be difficult for various reasons. The full table of reviewed papers related to the older construction worker using Pluye's MMAT (Pluye et al., 2011) can be found in Appendix A9.

The nature of construction work can cause further problems for older workers in comparison to white collar industries and the work has historically shown to be a potential cause of early retirement from the industry (Ringen et al., 1995; Brenner & Ahern, 2000). In Germany in 1996, 63% of all retirements from construction were found to be due to medical conditions (Arndt et al., 1996). During a five year follow up of 4,958 construction workers aged 40-64, 340 men retired from the industry due to disability of which the most important causes were diseases of the musculoskeletal and cardiovascular systems (Arndt et al., 1996). The longitudinal nature of this study provides a high level of reliability however this research could have been improved by following up the retirees to gain further information regarding their reasons for leaving.

Construction work can often expose workers to a number of harmful substances which can become more harmful as the body's immune system declines with age. In a study of 142 workers with an average age of 48, 94% reported exposure to dust and noise during their entire working history (Deacon et al., 2005). In addition to this, 20% reported exposure to dust, noise, chemicals, paint, stress, fumes, asbestos and cement however there were no measures taken to assess whether or to what extent any health problems reported were directly related to these exposures of any type of work tasks (Deacon et al., 2005). Despite the lack of work-related measurements, it is important to remember that these hostile environments are very likely to exacerbate natural age-related declines in physiological functioning and also increase the likelihood of age-related illnesses and diseases. The number of workers suffering with skin disorders such as eczema and dermatitis increases linearly with age, as does the time taken to recover from such conditions (Irvine et al., 1994; Deacon et al., 2005). Working in dusty environments with poor ventilation can lead to chronic obstructive pulmonary disorder (COPD), sufferers of which are significantly older (Dement et al., 2010).

Age-related declines can cause increases in risks specific to construction work; visual deficiencies can result in a higher risk of slips trip and falls in a workplace which is constantly changing and a decrease in hearing ability can lead to problems with hearing alarms and the passing on of instructions on noisy sites with various heavy machinery and loud work taking place (Koningsveld & van der Molen, 1997; Leaviss et al., 2008a). Physical work capacity starts to decline noticeably between 40-50 years of age (Ilmarinen & Rantanen, 1999) and this can severely impact the ability of workers to carry out heavy manual tasks in addition to affecting their general health and wellbeing. Despite this decline, a ten year study of over 75,000 blue collar workers found that older workers generally reported a lower perception of physical demands of work in comparison to younger workers (Hoonakker & van Duivenbooden, 2010) although the reasons for this perception were not explored further, suggesting that perhaps due to their decline in physical abilities, older workers may be being given less manual tasks to do. The decline in physical work capacity may also affect workers' ability to remain in awkward and cramped positions for long periods of time. However, Louhevaara (1999) found through the use of quantitative measures of dynamic and static postures, there were minimal to no differences between physical exertion and postures between young and older workers. Nevertheless, throughout this study there were times during data collection where maximum heart rate was almost reached, which may lead to additional health issues for older workers. Again this study did not provide the opportunity for qualitative data collection in order to gather data regarding the workers' perceptions of their demands at work; it is well documented that stamina and muscle strength decrease with age, suggesting that although these findings show no difference in postures and loading with age, workers' personal experience during these tasks may differ. Interestingly, Hoonakker & van Duivenbooden (2010) did investigate complaints regarding working in awkward postures and found that, through self-administered questionnaires from more than 70,000 construction workers, complaints increased with increasing age (Figure 5).

Figure 5: Complaints about working in awkward postures by age, 1993-2003
(Hoonakker & van Duivenbooden, 2010)



	93/94	95/96	97/98	99/00	02/03
<20	16%	17%	17%	17%	14%
20-24	20%	19%	18%	20%	16%
25-29	20%	19%	18%	20%	17%
30-34	22%	20%	21%	22%	18%
35-44	24%	23%	23%	25%	20%
45-54	26%	25%	25%	27%	23%
>/55	26%	25%	26%	28%	24%
Total	24%	23%	23%	25%	21%

Working in awkward and cramped positions for any length of time, coupled with the heavy manual work can significantly contribute to the development of musculoskeletal disorders. Musculoskeletal disorders are the most common cause of disability in construction workers (Arndt et al., 1996) and these have been found to dramatically increase with age (Ilmarinen & Rantanen, 1999). 18% of young construction workers reported lower back pain in comparison to 36% of workers aged over 55 (Holmström & Engholm, 2003) and Petersen & Zwerling (1998) found that older construction workers in the US were 1.4 times more likely to suffer with a back problem and 1.3 times more likely to have a foot or leg problem. Older workers reported more complaints of the upper and lower extremities such as the back, neck and knees over a ten year period and also had a higher rate of attributing these complaints to work in comparison to younger workers (Hoonakker & van Duivenbooden, 2010). Retirees from the construction industry report that they have a significantly lowered quality of retired life as a result of their work prior to retirement. Through focus groups and a survey of retired construction workers, Lemasters et al., (2006) found that many construction retirees suffered with health problems which restricted their enjoyment of retirement, such as chronic shoulder pain restricting hobbies and a decreased hearing ability leading to difficulty in social situations and feeling isolated. The use of focus groups allows for in-depth information to be collected by allowing participants to freely discuss their experiences with one another whilst simultaneously allowing the researcher to steer the discussion.

Despite experiencing various health issues in construction, older workers have reported that they want to stay in work (Buckle et al., 2008; Leaviss et al., 2008a). Retired construction workers feel pride in the buildings they have helped to create (Lemasters et al., 2006). Older workers are considered to be hard-working, dedicated, reliable and good at their job; they are respected in the industry by younger workers as a result of working in their trades for a number of years (Leaviss et al., 2008a). It has also been found that despite the high levels of musculoskeletal disorders in older workers, they have fewer injuries both at work and also in their own personal time (Everett, 1999; Hoonakker & van Duivenbooden, 2010). This may be as a result of their increased experience in the industry, taking fewer risks and making them safer on construction sites and in the workplace (Aghazadeh & Mital, 1987). The level of accidents in construction workers tends to decline steadily after the age of 28 to reach a low point aged mid-forty (Sawacha et al., 1999) and it was found that there were 12% more injuries in workers under the age of 40 than in older workers (Brenner & Ahern, 2000).

However, there have been discrepancies in these findings, particularly in construction industries in less well-developed countries where there are arguably less stringent health and safety regulations compared to Europe. In Israel, workers over 65 represent a high proportion of injured workers and lost time injury rates increase with increasing age (Pines & Halfon, 1987; Lipscomb et al., 1997). Arndt et al., (2005) found that the association between age and disability due to musculoskeletal disorders is U-shaped, with the highest incidences being in very young and much older workers.

2.5 Summary

The extant literature relevant to the research has been reviewed using a systematic, critical approach to analysis. The objectives of this chapter have been addressed and current knowledge about the ageing process and ageing at work has been described and discussed. Specific issues have been identified relating to the ageing process such as the decline in visual and hearing abilities, muscle strength and stamina; these natural declines can have a significant effect on an individual’s ability to perform well at work and can also increase the likelihood of ill health and injury. However, there has also been research acknowledging the positive health benefits provided by remaining in work for longer, such as better cognitive development and the prevention of ill health.

Construction has been shown to be a tough industry to work in and a hostile environment, this coupled with natural age-related declines make older construction workers particularly vulnerable and at risk of ill health and diseases. Further research is therefore needed into how the older construction worker can be accommodated in the workplace, in light of the ageing workforce being seen in the UK and worldwide. Throughout the review of the previous research into the construction industry and older construction workers, gaps in knowledge have been identified. For example, there is a lot of research into the health and safety of construction workers in addition to research into their wellbeing, however there is very little (or no research) on the part construction workers themselves play in this.

To address the identified gaps, the proposed research consists of three studies: Study one will explore what construction workers understand about their health and wellbeing at work and capture any ideas they may have to improve this, in order to enable healthy working behaviours and longer working lives. Study two will develop these findings with senior stakeholders in the construction industry to identify opportunities and barriers to change in the industry to facilitate healthy working. Study three will work with both trades’ workers and senior stakeholders to contribute to the development of an impact resource for the industry. This resource looks to will provide guidance and recommendations for workers of all ages to encourage and enable workers to remain in their trades for as long as they wish.

3. Methodology

A critical review of the published literature relating to ageing and construction workers has been conducted. It confirms the need for further research to explore how workers can remain in their trades for as long as they wish through better job and workplace design, promoting longer working lives. Within the context of the proposed research, ‘job design’ is defined as “the mechanisms through which job characteristics affect employee outcomes such as performance and wellbeing” (Holman et al., 2012), such as job rotation and consideration of the task before commencement. Joroff et al., (2003) claim that the design of the workplace is an integral part of the work itself within the relationship between work, the workplace and the tools of work. In this chapter, methodological approaches have been reviewed such as fixed and flexible design, mixed methods, survey studies and experimental methods. Sampling techniques and assessment tools are also discussed in relation to the theory of participatory ergonomics as a basis for this research. Participatory ergonomics is an approach which encourages involvement of the end-user, through discussions and idea generations for potential interventions (Wilson & Corlett, 1995; Hignett et al., 2005). Research has shown that using this approach can result in successful implementation of change within workforces (Loch et al., 2010; Tappin et al., 2016).

The objectives of this chapter are:

1. To understand methodological approaches relevant to the study of construction workers, the difficulties they face in the industry, ageing in their trades and their ideas and thoughts for improving their health and wellbeing at work to encourage and facilitate longer working lives.
2. To document the advantages and disadvantages of different methods in the context of this thesis.
3. To identify specific methods appropriate for collecting data to satisfy the objectives of the research.

3.1 Research paradigms

Thomas Kuhn (1962) defined a paradigm as a:

> *"Set of common beliefs and agreements shared between scientists about how problems should be understood and addressed"*

There are many different paradigms; Figure 6 presents four opposing views according to Anderson (2013): positivism, interpretive/constructivist, critical and pragmatic.

Figure 6: Research paradigms *(Anderson, 2013)*

Paradigm	Ontology	Epistemology	Question	Method
Positivism	Hidden rules govern teaching and learning process	Focus on reliable and valid tools to undercover rules	What works?	Quantitative
Interpretive/constructivist	Reality is created by individuals in groups	Discover the underlying meaning of events and activities	Why do you act this way?	Qualitative
Critical	Society is rife with inequalities and injustice	Helping uncover injustice and empowering citizens	How can I change this situation?	Ideological review, Civil actions
Pragmatic	Truth is what is useful	The best method is one that solves problems	Will this intervention improve learning?	Mixed Methods, Design-Based

Positivism is based around the observation of human behaviour and assumes that objective knowledge can be gained through such observation or via direct experience. It is largely based on quantitative data as positivists look for the existence of a constant relationship between events or variables whilst testing hypotheses (Dash, 2005). The interpretive paradigm, also known as constructivist or naturalistic, uses qualitative methods to understand a person's unique world view and how this combines with various social constructs (Anderson, 2013). This paradigm argues that individuals themselves construct the reality around them. Critical research uses critical analysis and historic review to "right wrongdoings" and a pragmatic approach looks to facilitate human problem solving rather than prove or disprove hypotheses and uses mixed methods. This paradigm holds the view that the truth is “whatever works” (Anderson, 2013).

It has been argued that positivism does not allow for a full understanding of research into human beings due to its quantitative nature (Symon & Cassell, 2006). The proposed research intends to explore construction trades’ workers’ views and understanding about their health and wellbeing at work and any ideas they have to make their jobs easier, safer or more comfortable in order to ensure they can remain in their trades for as long as they wish. In-depth opinions and experiences need to be collected from the trades’ workers to explore these ideas; therefore interpretive or pragmatic approaches may be more appropriate based on their comprehensive, qualitative nature (Figure 6).

3.2 Research strategy

Robson (2011) describes the different strategies to consider when conducting research: fixed, flexible and mixed methods (Table 5).

Table 5: Summary of fixed, flexible and mixed methods research strategies (Robson, 2011)

Research Strategy	Characteristics	Types of design
Fixed design	• Tight pre-specification • Quantitative	• *Experimental:* The researcher actively introduces a change in order to observe the reactive behaviour • *Non-experimental:* there is no change to the situation, the researcher often observes the differences between groups
Flexible design	• Evolves during data collection • Qualitative	• *Case study:* developing detailed intense knowledge about a single 'case' • *Ethnographic study:* researcher becomes fully immersed, often for a long period of time, in a group, organization or community • *Grounded theory study:* this study generates theory from the data collected during the study
Mixed methods	• Multi strategy • Includes both qualitative and quantitative at different stages	• *Sequential explanatory:* collection and analysis of quantitative data is followed by collection and analysis of qualitative data • *Sequential exploratory:* collection and analysis of qualitative data is followed by collection and analysis of quantitative • *Sequential transformative:* priority can be given to either method of data collection and results are integrated during interpretation • *Concurrent triangulation:* both qualitative and quantitative data are collected separately and concurrently. They are then compared to see their convergence • *Concurrent nested:* a second method is embedded or nested within either a quantitative or qualitative method • *Concurrent transformative:* the method is guided by the researchers' specific theoretical perspective

Fixed research design strategies are more able to infer causality between variables however there are little to no opportunities to explore these relationships further due to the quantitative nature of the design. This type of design is popular in scientific studies relating to the physical aspects of ageing such as, age related changes in hearing thresholds (Brant & Fozard, 1990) and the decrease in muscle strength with increasing age (Song & Qu, 2014). These fixed strategies are also used for examining the effects of either purposefully introduced or naturally occurring variables such as the effects of rest breaks and stretching exercises on workers (Galinsky et al., 2007). Fixed design strategies have previously been used in specific construction research such as testing a biomechanical model for improving roofwork (Vink, 1992) and assessing the effects of morning exercises on muscle stretchability and joint flexibility in workers (Holmström & Ahlborg, 2005). Although these studies provided quantitative data with high validity, the fixed design nature of the research meant that the studies lacked in-depth qualitative data, such as the workers' opinions on the introduced interventions.

Qualitative, flexible designs have also been used in construction research, Phelps & Horman (2010), identified the need for a shift in research approaches in the industry as they recognised the limitations of using fixed quantitative design research. They claimed that no matter what the construction-related subject, "the same inherent technical and socio-technical issues abound". A more in-depth research design such as ethnography or grounded theory which can aid the explanation of human behaviours in construction is therefore needed (Phelps & Horman, 2010). Ethnographic approaches have previously been used in construction, although they are arguably more difficult to achieve successfully, as construction workers regularly move to work on different sites in short spaces of time. Ethnographic research allows researchers to see 'between the lines' and be aware of implicit and tacit meanings which are common on construction sites between workers and managers (Phelps & Horman, 2010). They also allow for more in-depth understanding of context factors and practices in smaller construction firms as well as more details on a wider range of topics and issues such as safety systems, knowledge, and beliefs which may not be easily captured using other measures of data collection (Moir & Buchholz, 1996; Dhar, 2011). Grounded theory is another flexible design strategy which is characterized by the evolution of a theory through data collection and analysis. Choudhry & Fang (2008) conducted an investigation into why operatives engage in unsafe work behaviour; using a grounded theory approach they were able to develop a theory based on emerging themes from their analysis of in-depth, semi-structured interviews. Themes were created based on answers from the workers about why they work unsafely; the grounded approach was 'useful in developing context-based descriptions and explanations' for the workers' behaviour' (Choudhry & Fang, 2008). This approach was also used by Broberg et al., (2011) in an industrial manufacturing context using participatory ergonomics for re-design; workshops were held with workbooks, games and scenarios to encourage workers to put forward ideas for re-design. A grounded theory approach was used to analyse these ideas by identifying the common themes proposed by the participants with the frequency of these ideas being taken as an indication of their importance to re-design (Broberg et al., 2011). The use of a grounded theory approach allows for the in-depth study of participants' thoughts and opinions which contributes to the 'construction of a theory from the data itself' (Charmaz, 2014).

It is acknowledged that for the proposed research, an ethnographic approach would undoubtedly provide in-depth, rich data however based on the peripatetic nature of the construction industry, consistent contact with regular workers can be difficult. In addition to this, access to construction sites is often restricted due to health and safety requirements meaning that it would not be suitable for the proposed research. The proposed research seeks to explore trades' workers' understanding of their health and wellbeing at work and their ideas that they have to make their jobs easier, safer or more comfortable. Based on this, the strategy adopted for the proposed research is a flexible design with a pragmatic approach and elements of grounded theory. Trades' workers and stakeholders will be consulted about their ideas to facilitate healthy working behaviours in the industry to encourage consideration of their health and wellbeing at work. Therefore the most appropriate data collection techniques are qualitative, such as in-depth interviews, questionnaires and focus groups to allow full exploration of ideas. Common themes within the interviews, questionnaires and focus groups will be analysed using elements of a grounded theory approach; the frequency of themes within the interviews such as workers' ideas and suggestions will be taken as indicators of their importance to the workers.

3.3 Trustworthiness: reliability, validity and triangulation

To establish a level of trustworthiness within research, it must have a high level of reliability and validity. Reliability relates to the stability of the outcomes of research; if a study has a high level of reliability, it should be able to be repeated using the same measures and yield very similar if not the same results. If a measure is not reliable, it cannot be valid (Robson, 2011). There are three main ways to test for reliability; test-re-test which measures the same participants twice using the same data collection method, inter-rater reliability, which requires two or more researchers to conduct the analysis in search of similar results and interim-item reliability which assesses how consistent scaled items are (Fellows & Liu, 2008). Validity refers to the accuracy of a result; to ensure a high level of validity, the researcher needs to have answered the hypothesis they set out to test. If a study suggests the presence of a link between two variables, this needs to be supported with robust evidence (Robson, 2011). The validity of a research study can be enhanced by the use of a triangulation strategy by collecting data from a number of sources using a variety of methods to answer a hypothesis. One risk of using triangulation is that these different sources may yield different results which may contradict the findings (Erlandson et al., 1993). There are four main types of triangulation (Denzin, 1988):

• Data triangulation	The use of multiple data sources in the study of the same subject such as workers, managers, health and safety professionals
• Observer triangulation	Multiple observers are employed which removes the potential bias that comes from a single person
• Methodological triangulation	The use of multiple methods of data collection
• Theory triangulation	Approaching data with multiple perspectives and hypotheses

3.4 Research methods

The proposed research will use a variety of research methods to collect relevant and appropriate data to explore the opportunities and barriers to facilitating change in the construction industry. In the context of this thesis, a number of survey-type methods were explored to collect trades' workers' ideas on how they could make their jobs easier, safer or healthier to enable longer, healthier working lives.

3.4.1 Questionnaires

Questionnaires are a popular way of collecting a large amount of data in a short period of time and can be administered in a number of different ways. When administered face to face, a questionnaire forms a type of structured interview however they can also be self-administered or sent out by post, email or online. Questionnaires can include both open and closed questions in addition to 'Likert Scales':

- Open questions: participants are encouraged to give more detail and explain why they have answered in a certain way
- Closed questions: participants are able to answer often one word answers such as "yes" "no" "maybe" "often" "rarely"
- Likert scale: participants use a rating scale to demonstrate the strength of their response such as "strongly agree" "agree" "neutral" "disagree" "strongly disagree"

An important disadvantage of using questionnaires is the low response rate (usually at or below 60%) however, with advances in technology questionnaires can now be sent out and completed by wider sample populations online meaning that response rates can increase. In previous years questionnaires were often sent out by post, requiring participants to complete and then return them by post. However, questionnaires can now be emailed to an entire cohort or links can be sent out for participants to complete online. Table 6 summarises the main advantages and disadvantages of questionnaires.

Table 6: The main advantages and disadvantages of questionnaires (Ackroyd & Hughes, 1981; Popper, 2004)

Advantages	**Disadvantages**
Quicker than interviews and often less expensive	No way of being able to tell if a respondent is telling the truth
Large amounts of information can be collected from large amounts of people	Participants may read questions differently leading different responses
Can be analysed quickly and more objectively than other methods	Due to reasons above, questionnaires can lack validity

Considering the peripatetic nature of construction sites, with workers often being paid on a basis of how quickly they work questionnaires are a popular data collection method in the industry. Historically, questionnaires used in construction are largely related to health and the presence of musculoskeletal disorders in workers (Ohlsson et al., 1994; Palmer et al., 1999; Ludewig & Borstad, 2003). However they have also been used to collect demographic information (Inaba & Mirbod, 2010; Oude Hengel et al., 2012), information on psychosocial work characteristics (Boschman et al., 2013), working conditions (Burström et al., 2012), safety behaviours at work (Feng & Wu, 2013) and the willingness to continue working in the industry (Oude Hengel et al., 2012). An important limitation of questionnaires is that they do not offer the opportunity for exploration of participants' responses. This limitation can be overcome by using questionnaires as either an element of a structured interview or as the basis for a semi-structured interview schedule. Modifying questionnaires to be used more flexibly within interviews allows for more in-depth exploration of participants' responses which can increase the validity of this data collection method.

3.4.2 Interviews

There are three main types of interview; structured, semi-structured and unstructured. A strongly structured interview is essentially a spoken questionnaire, with prearranged questions. Less structured interviews allow the researcher more freedom in terms of the depth and direction of discussion with the participant. Semi-structured interviews are usually characterised by having an interview schedule which identifies certain topics or questions to be answered. An unstructured interview develops around the participant with very little direction from the researcher and is often informal. Interviews can include both open and closed questions; open questions are used to encourage discussion and elicit opinions whereas closed questions are designed to find out specific facts and rarely offer the opportunity for further discussion (Allison et al., 1996). Semi-structured and unstructured interviews are a common feature of a flexible design strategy (Robson, 2011). Table 7 shows the advantages and disadvantages of interviews.

Table 7: Advantages and disadvantages of interviews *(Robson, 2011)*

Advantages	Disadvantages
Provides in-depth, rich detail	Time consuming
Flexible – interviews can change direction depending on what is important to the participant	Possibility of researcher bias as the interviewer could steer the discussion in a certain direction
Opportunity to observe participants' behaviour which could add depth and value to the findings such as non-verbal cues	Concerns about reliability as inevitably participants' answers may change or the discussion may change due to the interviewer's mannerisms

Interviews have been used extensively in previous research in a number of different industries such as assembly work (Miguez et al., 2012), apple harvest workers (Earle-Richardson et al., 2005), business drivers (Gyi et al., 2013) and to extensively assess health problems such as hearing loss in children (Niskar et al., 1998), age related difficulties with activities of daily living and colour perception (Ishihara et al., 2001) and the persistence and consequences of eczema (Meding et al., 2005).

Interviews can be expensive and time consuming depending on the number of questions asked and how much the participant wants to discuss. They can however be conducted over the telephone with subsequent cost benefits although this eliminates the observation of visual cues and body language. They are also open to considerable bias, if there is only one researcher present, and care must be taken to ensure the participant is not 'steered' to answer in a certain way. Despite this, interviews have been used in construction research to assess safety and risk taking behaviours (Feng & Wu, 2013), workers' opinions on interventions (Kramer et al., 2009), the severity of injuries sustained on site (Gillen et al., 1997) and the impact of working conditions on health and career paths (Leaviss et al., 2008a).

Although interviews have been previously used in construction, there are potential difficulties with using them as a data collection tool. Much of construction work is paid "on price", meaning that workers are paid more money for completing the job ahead of, or on time. This can lead to difficulties with data collection on site as workers often strongly feel that they are losing money which could have a negative effect on their contribution. Equally, access onto building sites whether supervised or otherwise can be difficult, generally leading to problems when direct access to workers is needed such as data collection through observations. In many cases researchers may be required to complete a 'Construction Skills Certification Scheme' (CSCS) qualification to demonstrate awareness of site safety, in addition to site inductions for each site visited (Health and Safety Executive, 2007a).

3.4.3 Focus groups

A wider form of interview can be conducted using focus groups to facilitate discussion, with participants interacting with one another to gather rich and detailed data. They have been deemed to be popular because 'they do not discriminate against people who cannot read or write and they can encourage participation from people reluctant to be interviewed on their own or who feel they have nothing to say' (Kitzinger, 1995). They can also gather a large amount of data whilst allowing participants to 'bounce off' one another during discussions. However there is a risk that more boisterous individuals can take over the sessions so it is important that the researcher establishes an element of control. There is also a risk of less breadth of data being collecting compared to depth, as participants may become focussed on specific questions which may lead to digression in the form of wider discussion throughout the group (Robson, 2011). Table 8 shows the advantages and disadvantages of focus groups summarised by Robson (2011).

Table 8: Advantages and disadvantages of focus groups (Robson, 2011)

Advantages	**Disadvantages**
Natural controls – participants tend to provide checks and balances on each other	Confidentiality can be an issue with several participants at once
The experience is often enjoyable for participants	A fewer number of questions are usually asked
Very efficient	Researchers need to manage the group well

Focus groups have been shown to be useful in a number of previous research studies in the construction industry. Heller et al., (2007) used focus groups to examine work-related stressors being experienced by builders, Lombardi et al., (2009) conducted a series of focus groups to ascertain factors affecting the use of protective eyewear on construction sites and Gignac et al., (2006) conducted 16 focus groups with older participants to explore the effects of osteoarthritis. Focus groups often allow different themes to emerge as a result of discussion between participants that may not have been apparent if interviews were being conducted on a one-on-one basis. Additionally they may allow individuals to be more vocal if they feel other people in the group will support their opinions, such as Lombardi et al., (2009) who conducted focus groups to explore the use of protective eyewear on sites. They commented that 'participants generally agreed that older workers are more likely to wear PPE', 'many workers agreed about taster sessions' and that there was a 'unanimous issue for participants in the comfort of eyewear' (Lombardi et al., 2009). As previously discussed, many workers lose money by participating in research due to being on price work; having focus groups with several construction workers simultaneously may reduce this concern.

3.5 Sampling techniques

Sampling is crucial to all research studies; ensuring the appropriate participants are selected for specific research studies can affect the validity and impact of the findings for further populations. Depending on the type of research being carried out, a specific sample may be required such as certain age groups, occupations, illnesses or socio-economic status (Erlandson et al., 1993; Allison et al., 1996; Robson, 2011). A number of sampling techniques can be used which are reviewed in Tables 9 and 10.

Table 9: Probability sampling techniques (Robson, 2011)

Probability samples	**Description**
Simple random sampling	Selection at random from a population list
Systematic sampling	Taking every *n*th name from the population list
Stratified random sampling	Dividing the population into a number of groups (strata) and randomly selecting from within groups
Cluster sampling	Dividing the population into a number of units (clusters) which contain individuals with a range of characteristics Clusters are then chosen at random followed by the subpopulation being chosen at random
Multi-stage sampling	An extension of cluster sampling involving selecting the sample in stages i.e. sample of schools, sampled of classes, sample of students

Table 10: Non probability sampling techniques (Robson, 2011)

Non-probability samples	**Description**
Quota sampling	Obtaining representatives of the population in relative proportions to their occurrence in the population
Dimensional sampling	An extension of quota sampling. At least one representative of every possible combination of factors or dimensions in a research study is included within the sample
Convenience sampling	Choosing the nearest and most convenient persons to act as respondents. The process is continues until the required sample size has been reached
Purposive sampling	Building up a sample which satisfies the specific needs of a project
Snowball sampling	Initially sampled participants are used as informants for future participants until the sample size has been reached

Purposive sampling is often used when researchers are following a grounded theory approach; carrying out initial sampling and evolving the sample based on the initial findings and analysis (Allison et al., 1996). It allows for rich data to be collected from relevant participants, to maximize the range of information that can be obtained and is more appropriate when the findings of a study do not need to be generalised to wider populations (Erlandson et al., 1993).

Sampling in construction can be difficult due to the peripatetic nature of the workforce; workers rarely stay in one place which makes random or systematic sampling very difficult. These issues are identified by Fellows & Liu (2008) who stress the importance of environmental variables, such as the changeable nature of construction sites, when conducting research in context. A variety of different sampling methods have been used in construction research, depending on the population of interest. Several research studies have made use of accident and health databases and workers' registries where systematic sampling is easier (Lipscomb et al., 1997; Bock et al., 2003; Lipscomb et al., 2010; Boschman et al., 2012), further studies have made use of longitudinal studies which already have a secure sample population available to use (Arndt et al., 1996; Petersen & Zwerling, 1998; Latza et al., 2000).

Stratification of a sample involves separating participants into groups, usually defined by a characteristic such as age (Dong et al., 1995). The use of a stratified sample has the potential to increase validity by ensuring the sample is representative of the population, however it can also be time consuming, as characteristics by which the participants will be stratified must be known before the study can commence (Levy & Lemeshow, 2013). Stratified sampling is a popular technique in construction research to allow for easy comparison between groups; Lipscomb et al., (1997) stratified union carpenters by their age, sex, time in the union and their predominant type of carpentry work whereas Dement et al., (2005) stratified their sample of older construction workers to explore trends in hearing loss prevalence by age, employment duration and cigarette smoking history. Lipscomb et al., (2010) investigated injury estimates in construction workers by stratifying their sample by body part involved, diagnoses of injury and disposition of emergency department treatment.

Other methods of sampling in construction research have been volunteer sampling through unions (Ludewig & Borstad, 2003) and convenience sampling (Gillen et al., 1997; Rawlinson & Farrell, 2008). Cook et al., (2009) experienced difficulty in accessing a wide enough sample to investigate health disorders related to construction work and therefore had to widen their sample population to include 'sufferers' in the general population, which weakened the validity of their findings.

For the proposed research, considering the peripatetic nature of the construction industry and the practical constraints of site access, using purposive sampling will ensure that relevant and rich data is collected. Stratifying the sample in terms of age and trade will allow comparisons between these characteristics.

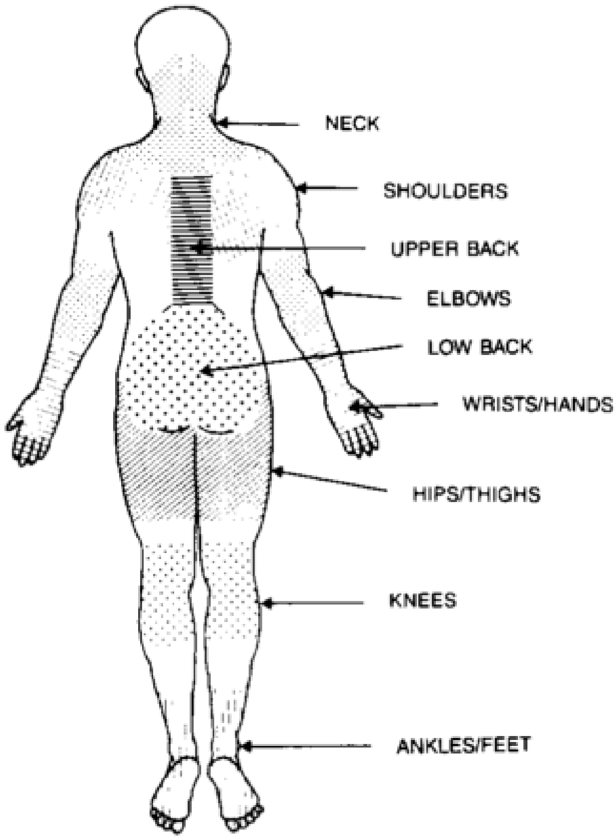
3.6 Assessment tools for research in construction

A critical review of research studies in Chapter 2 identified a number of different methods for collecting data in the construction industry. These will now be discussed including the Nordic Musculoskeletal Questionnaire, the Work Ability Index and ways of measuring the effects of physical workload on the body.

3.6.1 Nordic musculoskeletal questionnaire

The Nordic Musculoskeletal Questionnaire (NMQ) was proposed by Kuorinka et al., in 1987 for analysis of the prevalence of musculoskeletal symptoms. It was designed to answer the question "do musculoskeletal troubles occur in a given population, and if so, in what parts of the body are they localised?" (Kuorinka et al., 1987). It was also designed to be administered either as part of an interview or as a self-administered questionnaire. A picture of a body with nine identified areas is included so that participants can indicate where they were experiencing symptoms (Figure 7).

Figure 7: Image from the original NMQ *(Kuorinka et al., 1987)*



In this picture you can see the approximate position of the parts of the body referred to in the questionnaire. Limits are not sharply defined, and certain parts overlap. You should decide for yourself in which part you have or have had your trouble (if any).

Different modifications of the NMQ have been used over the past 25 years and it has been used in many industries to assess the level of discomfort experienced by individuals, such as railway, aviation and university workers (Driessen et al., 2008), pharmaceutical sales representatives (Sang et al., 2010), business drivers (Gyi et al., 2013) and various different occupations within a population (Widanarko et al., 2011). The NMQ has also been used for assessing musculoskeletal symptoms in construction workers (Cook et al., 1996; Reid et al., 2001; Holmström & Engholm, 2003; Williams et al., 2011).

Modified versions of the NMQ have included questions to explore the prevalence of musculoskeletal symptoms (12 months and 7 days), whether the symptoms are work-related and how severe the symptoms are (whether they have prevented day to day activity). Like many questionnaires, there is little to no room for open questioning, which can lead to a lack of in-depth results, however the NMQ could be used as part of an interview to discover more information about the causes and effects of symptoms. As the musculoskeletal symptoms are self-reported, this could lead to a biased set of results; medical examinations by qualified health professionals are the only way musculoskeletal disorders can be officially diagnosed. Nevertheless, the NMQ has been tested for reliability using a test-retest method and was found to be an acceptable screening tool (Crawford, 2007). Although the NMQ is a qualitative data collection tool, the prevalence of symptoms can be statistically analysed which can provide additional quantitative data to a research study.

3.6.2 Work ability index

The Work Ability Index (WAI) was proposed by Ilmarinen (1991) based on data from 6,500 workers in various occupations. Work ability was defined by the question 'How good is the worker at present and the near future, and how able is he/she to do his/her job with respect to work demands, health and mental resources?' There are a total of 7 questions, each answerable via a rating scale. The total of these ratings give an overall work ability rating which allows the researcher to assess how able to worker is to complete their given tasks. The WAI is the most popular measure to determine workers' ability to continue with their tasks and is available in 21 languages (van den Berg et al., 2008a).

The questionnaire has been shown to deliver consistent results however it does not provide an opportunity for participants to explain why they have given a particular rating at a particular time. The questionnaire does not account for extraneous variables such as additional stressors, work/home life balance and so on, all of which may affect an individuals' perception of their ability to work. The WAI has been assessed for reliability using a test-retest method with four week intervals using a relatively small sample of 97 construction workers aged 40 and over (de Zwart et al., 2002). Over the four week test period exactly the same scores were reported by 25% of the workers suggesting a high level of reliability. The WAI has been used consistently in research into ageing (Ilmarinen & Rantanen, 1999; Oude Hengel et al., 2012; Koolhaas et al., 2015) and in different industries such as railway construction workers (Capanni et al., 2005), workers in commercial services (van den Berg et al., 2008b), home care workers (Pohjonen & Ranta, 2001) and also frequently with construction workers (Liira et al., 2000; de Zwart et al., 2002; Welch et al., 2010).

This questionnaire is a quick and simple data collection tool, making it a useful measure of work ability in construction research.

3.6.3 Stage of change questionnaire

The Stage of Change (Transtheoretical Model) was initially proposed by Prochaska & DiClemente (1983) to explain the behaviours and stages experienced when ceasing an addictive behaviour such as smoking. Figure 8 and Table 11 illustrate and describe the six stages respectively.

Figure 8: Stage of Change Model *(Prochaska & DiClemente, 1983)*

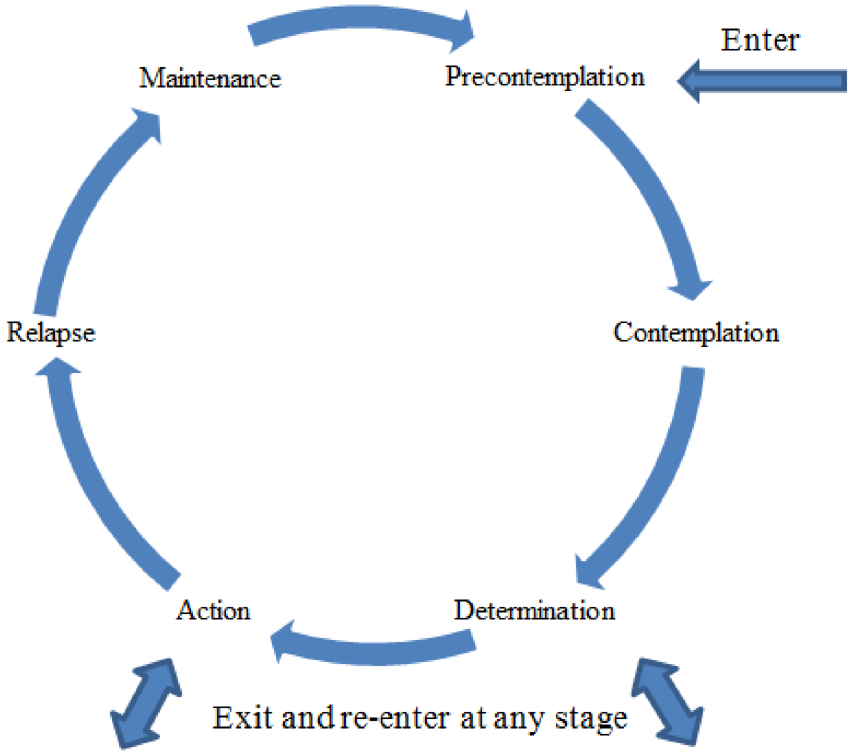


Table 11: The six 'stages of change' *(Prochaska & DiClemente, 1983)*

Stage of change	**Description**
1. Precontemplation	Occurs before the individual has considered cessation
2. Contemplation	The individual is thinking about stopping within the next six months
3. Determination	The individual is getting ready to change within the next month
4. Action	The individual makes the changes required
5. Relapse	A stage which not every individual goes through, but if it does occur the individual returns to any of the four previous stages
6. Maintenance	Specific changes have been made to the individual's lifestyle

Although ‘relapse’ is identified as a specific stage, individuals can exit and re-enter the cycle at any stage. The Stage of Change questionnaire has been used in a number of areas such as cessation of smoking and drinking and also in encouraging exercise. In 2007 the questionnaire was modified to assess both workers and managers’ readiness to change in relation to the reduction of work-related musculoskeletal disorders (Whysall et al., 2007). The modified version of the questionnaire has been used to assess workers’ awareness of musculoskeletal disorders and their readiness to change to improve these risks with a variety of workers such as cleaners, joiners and plumbers (Punchihewa & Gyi, 2009), business drivers (Gyi et al., 2013) and construction workers (Village & Ostry, 2010).

A limitation of the questionnaire is the lack of detailed data it can collect unless the researcher is prepared to put in considerable additional time by using supplementary interviews or questioning (Whysall et al., 2007). It is also important to consider the potential bias when asking individuals to report how ready they are to change; in certain industries such as construction where often employability is uncertain, workers may be reluctant to appear keen for change or vice versa if they feel this could negatively affect their relationship with their managers or supervisors and therefore risk their future employment.

3.6.4 Posture analysis

A common measure in construction research is that of postures and loading on workers’ bodies; these factors can considerably increase the risk of injury, ill health and the development of musculoskeletal disorders therefore a significant number of different methods have been used in previous research.

To measure posture in construction workers, observations are the most common data collection method, in combination with other measurements, for example inclinometers and data loggers are used to measure postures of upper limbs (Moriguchi et al., 2013) and photographs can be taken and assessed using RULA (Rapid Upper Limb Assessment) (Miguez et al., 2012). Tak et al., (2011) used a combination of two techniques: PATH (postures, activities, tools, handling) which allows for ergonomic estimates of exposures and OWAS (Ovako working posture analysis system) which uses the posture codes from PATH to define ranges of angles in specific areas of the body i.e. upper limb, neck, trunk (Tak et al., 2011). Louhevaara (1999) also used the OWAS method to quantify the physical work load of blue collar workers after observing dynamic, static postural and perceived workloads; heart rate and energy expenditure levels were also measured. A method known as REBA (Rapid Entire Body Assessment) has been developed to enable the recording of unpredictable working postures; the tool codes segments of the body individually, based on movement planes and provides a scoring system for muscle activity (Hignett & McAtamney, 2000). REBA has been used to investigate and reduce work-related musculoskeletal disorders (Whysall et al., 2004; Punchihewa & Gyi, 2009) and from a sample of 17 Canadian certified ergonomists, it was found that 53% used REBA as a reliable ergonomics analysis tool (Pascual & Naqvi, 2008).

As demonstrated, there are a wide variety of measures available to collect data relating to postures and load in construction workers. Each of these methods has their own advantages and disadvantages therefore using a combination of measures is likely to yield more valid and reliable results. For the proposed research, considering the restrictions of access to construction sites and trades' workers, working loads and postures will not be measured as it will be difficult to secure permissions on site. In any case it is already widely acknowledged and evidenced that construction workers have heavy manual jobs which can strongly affect their postures at work. The interest of the proposed research is directed towards what ideas workers have to improve their jobs and to make them healthier, safer or easier. The research looks to explore how healthy working behaviours and practices can enable construction workers of all ages to remain in their trades for as long as they wish.

3.7 Participatory ergonomics

Participatory ergonomics (PE) has been defined by John Wilson (1995a) as:

> *"the involvement of people in planning and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both processes and outcomes in order to achieve desirable goals"*

It is an approach which has been applied in a number of industries, companies and occupations in order to improve the health and wellbeing of the worker and also the work ability and productivity of the workforce. Papers relevant to participatory ergonomics have been reviewed using Pluye’s MMAT (Pluye et al., 2011) and can be found in Appendix A10.

Participatory ergonomics works on the basis that involvement of the end user will significantly increase the potential success of interventions and changes to the workplace (Hignett et al., 2005). Essential to the success of participatory ergonomics is the participation of both the workforce and stakeholders within an organisation, requiring teams to work together to produce tangible solutions to ergonomic problems. Despite the development of solutions and interventions with the workforce, the advice of an ergonomics specialist is still necessary to ensure solutions are ergonomically viable (Wilson, 1995a).

Participatory approaches can be applied in any workplace; in preparation for their increasingly ageing workforce, BMW created a pilot production line made up of the demographic of workers they expected in 2017, with an average age of 47 (Loch et al., 2010). Through a participatory process, during which all ideas from workers were seriously considered, 70 workplace changes were implemented such as new flooring to reduce knee impact and improved seating for break times for workers. After one year the pilot line had productivity levels as high as lines staffed by younger workers and absenteeism had dropped below the plant average (Loch et al., 2010). Participatory ergonomics can improve worker-manager relations as the process requires a high level of communication and commitment from all workers. However, this study may have been successful due to the static nature of the workforce. In contrast construction companies are typically made up of smaller, more transient workforces due to the peripatetic nature of the industry meaning that self-employed workers frequently move to and from different companies. Participatory approaches are therefore more difficult to initiate in construction companies, due to the temporary nature of the workforces. The involvement of older workers in interventions to encourage workers to remain in work for as long as they wish to has also proved successful in other larger companies such as B&Q, Sainsburys, Asda and McDonalds (Department for Work and Pensions, 2011). Older workers in these companies were encouraged and enabled to remain in work for as long as they wish by the companies offering more flexible working initiatives to account for personal commitments such as caring for grandchildren (Department for Work and Pensions, 2011).

Despite static, more permanent workforces arguably having more success with participatory ergonomics approaches, it has still been tried with transient workforces such as those found in the construction industry. Vink et al., (1997) used a PE approach with two scaffold building companies and found that the uptake of new interventions was considerably lower. Following 'solution sessions' with the scaffolders themselves, ideas were suggested to improve work tasks including commissioning the cleaning of scaffold pipes before they are broken down, use of an electrical winch to assist heavy lifting and the development of a palette truck to alleviate heavy manual handling. Whilst all workers felt that they had satisfactory input to the process, there was a considerably low uptake of the interventions; only 30% working with the electrical winch and low expectations for the shoulder protection and lifting training interventions. This study suggests that a participatory approach may be less effective in certain situations, particularly where workers feel they are still fully able to do a job themselves without any changes. More recently, Hess et al., (2004) used a participatory approach to evaluate the use of skid plates used by concrete labourers. This allowed the researchers to get in-depth feedback about the mechanisms of the skid plates and how they would be used on work sites (Hess et al., 2004). Moir & Buchholz (1996) claim that PE approaches may be essential in industries such as construction because the workers themselves are completely embedded in their trades, their tasks and their environments and are therefore considered to be experts, who should be consulted for future interventions.

This approach has also been shown to be successful in a variety of organisations and workplaces; Gyi et al., (2013) used a participatory approach to effect change for high mileage business drivers, Moore & Garg (2003) successfully and significantly decreased the prevalence of recordable musculoskeletal disorders of workers in the red meat packing industry and Guimarães et al., (2014) introduced multiskilling and teamwork by using a participatory ergonomics approach in a Brazilian footwear company. Involving workers from the beginning of an intervention process increases the likelihood of success and 'buy-in' of workers as they feel a sense of pride and ownership (Hignett et al., 2005). This also in turn increases success rates as workers are more likely to discuss their ideas with colleagues, encouraging further uptake within the workforce. PE approaches also mean that developed interventions can be tailored to companies' specific needs and requirements which has the potential to increase productivity within the workforce (Gyi et al., 2013). Interventions can improve health and wellbeing in the workplace which can also improve productivity and job satisfaction. Loisel et al., (2001) created an ergonomic intervention programme for back pain sufferers. With 37 workers randomized to the program, risk factors such as posture, excessive use of strength and safety hazards were targeted for ergonomic solutions. Overall, 68% of employer representatives and 54% of injured workers reported that the interventions had increased awareness of back pain risk factors in the workplace. However, this study did not appear to control for extraneous variables, meaning that these workers may have naturally increased their awareness of back pain and this may not be as a direct result of the interventions. It is also unclear how much involvement the participants had in the process of the intervention, which may have had an effect on the success of the program.

In participatory ergonomics interventions, smaller sample sizes are often more effective than larger which makes the approach suitable for the peripatetic nature of the construction workforce. Participants need to have good knowledge and experience of their workplace and work tasks in order to select the most appropriate interventions. Smaller sample sizes removes the need for 'representatives' of a workforce and instead means that all workers can be involved in the process. Wilson (1995a) carried out a participatory ergonomic intervention with 5 crane operators to improve their control room; the resulting interventions included changes to seating and control operation. The intervention was considered a success, as the workers and managers continued to address ergonomic issues in the absence of the ergonomist. This suggests that successful participatory approaches can provide longitudinal benefits for workers and companies alike, saving lost time due to occupational health issues and injury as well as creating a more productive and satisfied workforce.

A disadvantage of PE is that it can be a long process; for it to be successful, workers should be involved from the very beginning, which can cause problems in large, transient workforces. Those involved in interventions should ideally be representative of the whole workforce in order to maximised inclusion of the highest number of workers however this can be difficult. The larger the workforce, the more difficult it becomes to engage all workers and ensure that the intervention will be appropriate for them. Reasons for interventions not working can include disruption of work procedures and limitations of time, money and resources within companies (Loisel et al., 2001). Not all the workforce may want to participate, which can make the introduction of interventions difficult. If workers do not want to invest time in interventions it can lead to them feeling alienated, which in turn could decrease their job satisfaction and have a negative effect on productivity (Wilson, 2005b). Overall, PE provides a good foundation to effect change in industries by encouraging workers to take ownership, and generate and share ideas. Encouraging user input from the beginning can increase the potential success of an intervention.

3.8 Summary

The objectives of this chapter have been addressed and research paradigms, strategies and data collection methods have been identified and reviewed. A research methodology appropriate for the study of workers in the construction industry has been identified and understood and the advantages and disadvantages of different methods have been critiqued in the context of this research.

The proposed research will use a flexible design methodology, characterised by a pragmatic research paradigm. This will be to facilitate human problem solving, such as the difficulties faced by construction workers related to their health and wellbeing in their trades. This methodology will be employed with the use of data collection tools such as interviews, questionnaires and focus groups to ensure rich, in-depth data is collected. These methodological approaches are considered to be the most appropriate for the exploration of the understanding workers have about their health and wellbeing at work and any ideas they have to make their jobs or workplaces easier, safer or healthier. Ideas from the workforce will then be considered in focus groups with senior stakeholders in the industry to ascertain the opportunities and barriers to facilitating change. A purposive, stratified sampling strategy will be employed to ensure the most appropriate participants are used for study. For the purpose of this research and due to practical constraints such as access to construction sites and workers on site, working postures will not be analysed. It has already been identified that construction workers of all ages are required to carry out heavy manual work and the resulting risks to musculoskeletal health have been well documented. A participatory ergonomics approach will also be taken to encourage workers to take responsibility for their health and wellbeing at work and share ideas to enable longer, healthier working lives in construction.

4. Study one: interviews with construction workers

4.1 Introduction

As the literature review identified in Chapter 2, the UK and global population is ageing and, as a result, there is an increasingly older workforce. This is creating a high demand for initiatives to encourage healthy ageing at work, across all ages to facilitate longer working lives. Previous research has shown that older workers are highly skilled and that their experience and knowledge is valued and respected by workers of all ages. For the health and wellbeing of construction workers to improve, it is vital that this experience is not lost and that the assets of older workers are realised. As the review of previous construction research in Chapter 2 identified, construction workers are experienced and knowledgeable and have ideas and suggestions to improve their health and wellbeing at work which can also contribute to healthy ageing. In addition, using a participatory ergonomics approach to involve users in the development of new interventions can successfully lead to higher levels of work ability within the workforce (Vink et al., 2002; Leaviss et al., 2008b; Miguez et al., 2012).

4.2 Aims and objectives

The aim of this chapter and of this first research study was to capture workers' views on health and wellbeing at work and to explore their ideas to facilitate healthy working behaviours and healthy ageing in the workplace.

The objectives of this chapter are:

1. To capture the prevalence of musculoskeletal symptoms in workers from construction trades and measure the effect on work ability.
2. To explore workers' views on health and wellbeing at work and the factors that might influence these when working in their trades.
3. To capture workers' ideas to make their jobs easier, safer, healthier or more comfortable.

To achieve these objectives, an exploratory study was conducted using in-depth semi-structured interviews to investigate the extent to which construction workers can contribute to changes in the workplace in order to improve their health and wellbeing.

4.3 Sampling

Due to the peripatetic nature of the construction industry, there is a high turnover of staff due to many workforces being subcontracted. A purposive sampling strategy was used whereby site managers were asked to identify workers of all ages in specific manual trades such as bricklayers, electricians, plumbers and carpenters to participate in interviews. Care was taken to ensure the sample was as random as possible with site managers selecting participants to be interviewed based on a homogenous group of workers in addition to exclusion criteria such as being under 18 years old, being non-English speaking and being in trades that did not require heavy lifting, twisting, turning and repetitive movements such as machine operators. Robson (2011) quotes purposive sampling as “enabling the researcher to satisfy their specific needs in a project” and is also cited as a sampling technique “most effective when one needs to study a certain cultural domain with knowledgeable experts within” (Dolores & Tongco, 2007). Participants were grouped in terms of age (under 25, 25-34, 35-49 and 50+) with 50+ chosen as the ‘older worker’ age range in line with previous research and government initiatives (Loretto & White, 2006a; Taylor, 2006). Selecting a broad age range (under 25 to 50+) ensured that ideas and opinions could be harnessed from construction workers with varying levels of experience and knowledge.

Site managers of three organisations were approached and contacted via email and telephone; using snowball sampling from each contact, a total of 90 construction trades’ workers were recruited for interview from numerous geographical sites in the UK ($n=8$) however only 80 workers were eligible for analysis due to exclusion criteria. Snowball sampling enables relevant participants to be recruited from the population of interest and is seen as a particular type of purposive sampling (Robson, 2011). Construction is a male dominated industry and this was reflected in the sample; only one female was available for interview and to the researchers’ knowledge, this was the only female construction worker on any of the sites involved. This participant was still included as gender was not part of the exclusion criteria and this participant represented the younger age category (under 25) in a relevant trade (electrician).

4.4 Study design, rationale and ethics

Eight site managers from three organisations were briefed on the study in order to select appropriate participants who would be available for interview. Contact was attempted with the site manager of a fourth organisation; however despite numerous attempts at contact via telephone, email and through other members of staff, the connection was never made. Ethical approval was issued in March 2013 by the Ethical Advisory Committee at Loughborough University.

The researcher worked with site managers to secure appropriate dates and times for participants to be interviewed. Before the researcher could enter the construction sites, a Construction Skills Certification Scheme (CSCS) exam was completed to validate their site health and safety knowledge and competency. The researcher then travelled to the sites to meet with the site managers before beginning data collection. Participants were given an information sheet to read prior to the interview, explaining the purpose of the study and what was expected of them (Appendix A11). Following this, they were informed of their right to withdraw from the study at any time and gave their consent to have photographs and/or videos taken of them in addition to the interview being audio recorded to supplement interview data. Participants were then asked to sign an informed consent form (Appendix A12) if they were happy to take part.

4.5 Interview Schedule

Based on a review of previous literature and methodologies (Chapters 2 and 3), an interview schedule was developed to explore participants' knowledge and thoughts on the construction industry, their understanding of their health and ageing at work and the development of ideas and interventions to improve this. Four main themes were used as broad discussion points; demographics, their job, ideas for changes to the workplace and their health at work. These are summarised in Table 12 and described more fully later in this section.

Interviews were designed to last approximately 30-45 minutes and the interview schedule ensured that all topics of interest were covered whilst simultaneously allowing participants to talk freely and at length about their trades and any ideas they had for healthier and better working, characteristic of a semi-structured interview (full interview schedule, Appendix A13).

Table 12: Summary of questions and issues discussed during interviews

Discussion points	Questions and prompts
Demographics	Age range. Trade. Company/Employer. Site. Time spent in employment.
Their job	Day to day tasks. Tools and equipment used. Personal Protective Equipment (PPE) requirements and usage. Location of jobs. Awkward/cramped positions. Use of chemicals. Dust/noise. Risks to health and wellbeing.
Ideas for changes to the workplace	What ideas do you have to make your job easier? To make the workplace better? New/different equipment? Flooring, lighting, PPE, toolbox 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 plaster? Electricians – what do you do about extra lighting in small/dark areas? Bricklayers – what issues do you face with working outside? Weather? What is currently being done to make your job easier? Who comes up with these changes? Are you using different equipment? Are there specific rules/ways of working for older workers? Do you alter your current equipment? Order of jobs? PPE – wearing knee pads/particular gloves/other clothing modification?
Health	Stage of Change Questionnaire (Whysall et al., 2007) Nordic Musculoskeletal Questionnaire (Gyi et al., 2013) Work Ability Index (Ilmarinen & Rantanen, 1999)

Prompts and probes were used as appropriate based on each participant and how much they were willing to discuss; not all questions and prompts were used for all participants. Demographic data was obtained for statistical analysis such as age range, trade and length of time spent in the construction industry; this also served as an ice-breaker along with discussion around their day to day tasks as part of their job. The second theme, ‘their job’, also allowed the interviewer to determine the main issues experienced within each trade and encouraged participants to immerse themselves in thinking about their activities on a day to day basis. Participants were then asked about ‘ideas for changes to the workplace’ including ways to make their jobs easier and healthier or ways in which their health and wellbeing could be improved, considering ageing in their jobs and in construction. Prompts and probes were used based on previous information they had given about their jobs and the issues they may have experienced in their trades. The fourth theme, ‘health’ included quantitative data collection using modified versions of the Stage of Change Questionnaire (Whysall et al., 2007), the Nordic Musculoskeletal Questionnaire (Kuorinka et al., 1987; Gyi et al., 2013) and the Work Ability Index (Ilmarinen & Rantanen, 1999).

A modified version of the Stage of Change Questionnaire was used to facilitate discussion around how open participants were to change (Whysall et al., 2007). The openness to change of participants was determined by the answers they gave to a number of questions (Appendix A14); if participants had not made or had not considered making changes they were perceived to be in the pre-contemplation stage of change, a stage where the benefits of continuing their current behaviour outweigh the benefits of changes. When this balance migrates and participants see changing their behaviour as beneficial, they move to the contemplation stage where they consider making changes or the maintenance stage where they continue with the changes they have already made. At any point in this cycle, participants can experience relapse and return to the first stage.

In addition to qualitative data being collected, the ‘health’ theme within the interview schedule also allowed for quantitative data to be collected. A modified version of the Nordic Musculoskeletal Questionnaire (NMQ) was used to collect data about work-related musculoskeletal symptoms (Kuorinka et al., 1987; Gyi et al, 2013) (Appendix A15). This allowed for point (7 day) and period (12 month) prevalence of musculoskeletal symptoms to be measured in nine specific areas of the body and whether these were perceived to be work-related. This questionnaire also served as a facilitator for discussion, as the researcher was able to ask further questions regarding the perceived cause of any musculoskeletal complaints and whether any changes had been made as a result of these. A modified version of the Work Ability Index was used after the NMQ to collect workers’ perceptions of their ability to work and assess whether any reported musculoskeletal symptoms were affecting their work ability. Workers were able to provide an overall rating from 0 to 10, with 0 being ‘completely unable to work’ and 10 being ‘the best they have ever worked’ (Ilmarinen & Rantanen, 1999; Capanni et al., 2005) (Appendix A16).

Observations were carried out on site where necessary and possible to supplement interview data. However in the majority of cases this was not possible due to supervision requirements on construction sites. Where this was possible, ideas presented by workers were followed up by the researcher, with photographs and videos taken.

4.6 Data analysis

4.6.1 Qualitative data analysis

Interviews were recorded on a Dictaphone with the audio files then uploaded into NVivo10 software, wherein all interviews were transcribed verbatim. Each interview transcript was then coded thematically by the researcher within NVivo using quasi-statistical analysis (Miller & Crabtree, 1992). A quasi-statistical approach uses the frequency of references from participants to determine the importance of key themes within the interview. A template approach allows these key themes or ‘nodes’ (derived from an initial read of the data) to be used as a template for data analysis, which can change as analysis progresses. Main themes were identified and then further sub-coded to make them more specific. Quotes are used within the analysis below (Section 4.7.4.3 onwards) to support and illustrate the findings of the interviews.

4.6.2 Quantitative data analysis

Quantitative data were uploaded into SPSS Statistical Software for Windows and with the assistance of a statistics advisor from Loughborough University’s ‘Maths and Learning Support Centre’, were analysed using the most appropriate techniques, detailed below, in addition to basic descriptive statistics. Quantitative data were analysed with significant differences of $p \leq 0.05$ being tested for between variables.

Chi Square

Chi square is used to test for an association between two variables and answers the question "are the differences between the 'observed' and 'expected' cell counts large enough to infer an association in the tested population?" This test was used for nominal, non-parametric data. Chi square was used to test for associations such as prevalence of musculoskeletal symptoms with trade and also with age.

Fisher's exact test

When the expected counts within the Chi square test are less than 5, a Fisher's exact test is used. This is a more statistically sophisticated and robust test than others, such as Chi square as the p values can be calculated exactly rather than relying on an approximation that becomes more robust as the sample size increases.

Spearman's correlation

Spearman's correlation gives the measure of association between two variables with at least one being ordinal, such as 12 month prevalence of musculoskeletal symptoms and age ranges.

One way analysis of variance (ANOVA)

One way analysis of variance allows analysis of parametric data with two or more experimental conditions or with more than one factor, such as work ability rating with age and trade.

Kruskal-Wallis

Kruskal-wallis is the equivalent of a one way ANOVA but for non-parametric data.

4.7 Results

This section reports the outcome of an initial pilot study and the subsequent interview study; the findings of both quantitative and qualitative data collection will be presented. The results will be reported in line with the interview structure shown in Table 12, with the exception of the quantitative data ('health' section) being reported first alongside demographic data for continuity of data collection methods.

Quantitative data will be presented first with demographic data including the age ranges, trades and organisations of participants. The Stage of Change Questionnaire was removed as a data collection method following a pilot study (Section 4.7.1) however some results are reported. Results from the Nordic Musculoskeletal Questionnaire are next, being reported in relation to the age range, trade and organisation of the participants, followed by the results of the Work Ability Index Questionnaire. Qualitative data from the in-depth semi-structured interviews will be reported in line with the interview schedule (Table 12); with results about their job being reported and ideas for changes to the workplace.

4.7.1 Pilot study

The first site visited was treated as a pilot study, with 11 participants being interviewed. The interview schedule worked very well and as a result only one change was made for subsequent data collection; the removal of the Stage of Change Questionnaire as a specific data collection tool. It became apparent that the use of the questionnaire worked better as a facilitator for discussion rather than a data collection tool, as workers rarely answered 'yes/no' to the closed questions, making collection of specific data relating to their stage of change very difficult. However the questionnaire was useful for encouraging workers to consider changes that they may have subconsciously made in the workplace or to explore their perceptions of change in the industry therefore was retained as a more flexible data collection tool to prompt workers within the interview schedule. As this was the only change made to the structure of the interview schedule after the pilot study, data collection continued and data from the pilot study are included in the final sample ($n=80$).

4.7.2 Sample

A total of 90 construction workers were recruited and interviewed through personal and professional contacts. Sample size was defined considering the peripatetic nature of construction sites and the time it would take for the interviews to be conducted. Based on exclusion criteria, ten interviews were not analysed due to participants not being English speaking, or being in trades which did not require heavy manual labour such as machine operators, leaving a sample of 80.

Participants were recruited through a domestic build company (*n=40 – 10 excluded)*, a maintenance section of a facilities management organisation (*n=28)*, a civil engineering company (*n=16)* and through personal contacts (*n=6)*. Due to the small sample of personal contacts *(n=6)* and these participants not working with one of the three organisations involved in the study, these were excluded from quantitative data analysis. Figures 9, 10, 11 and 12 illustrate the process of how participants were interviewed. For example in Figure 9, the domestic build company was approached and the researcher was put into contact with 5 site managers. As previously described, the site managers randomly selected workers based on the exclusion criteria provided by the researcher, the resulting participant trades are illustrated within the figure.

Figure 9: Participants from domestic build company (n=40)

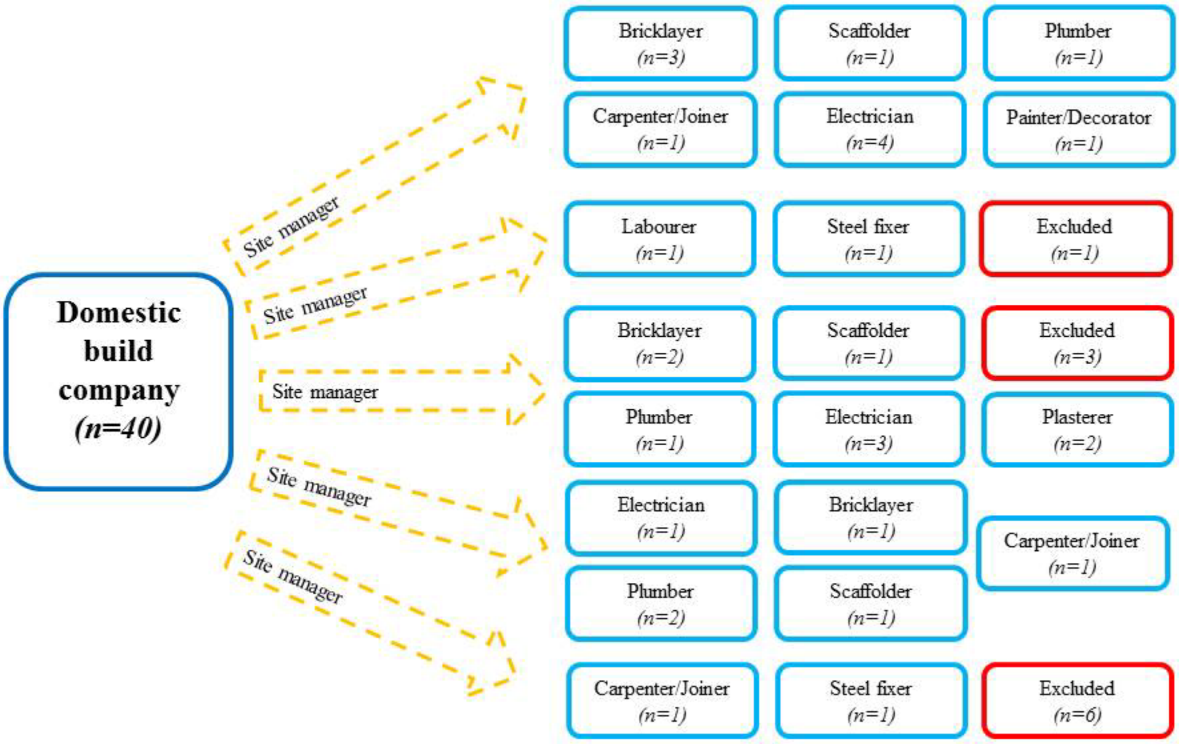


Figure 10: Participants from maintenance facility (n=28)

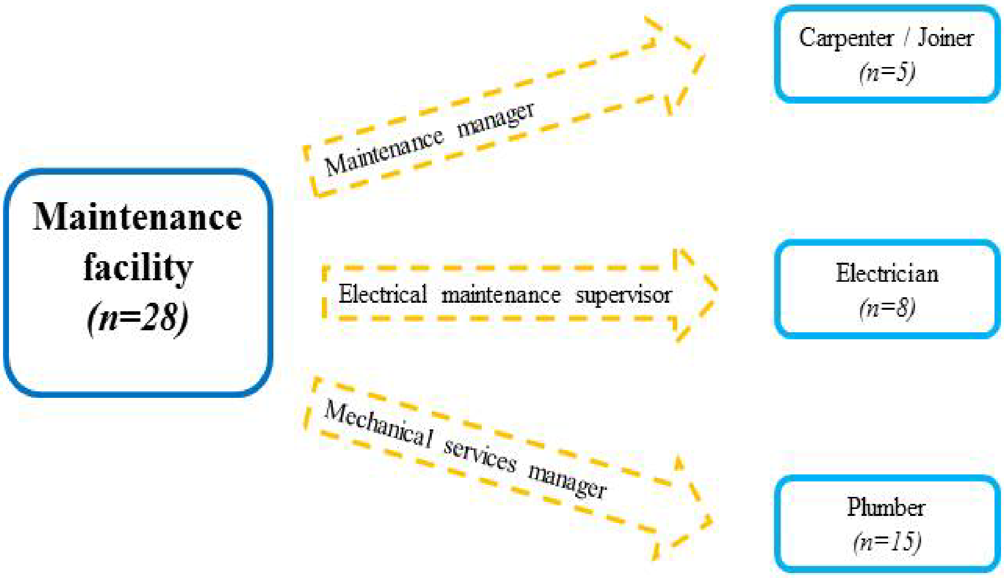


Figure 11: Participants from engineering company (n=16)

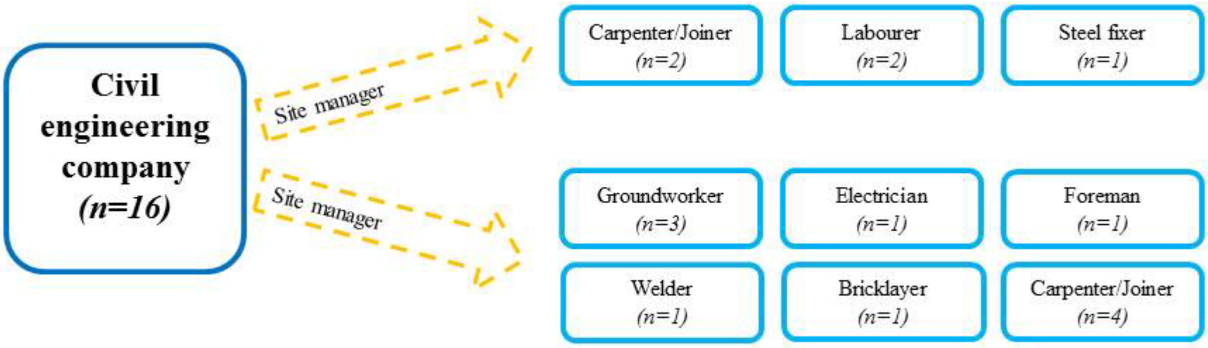
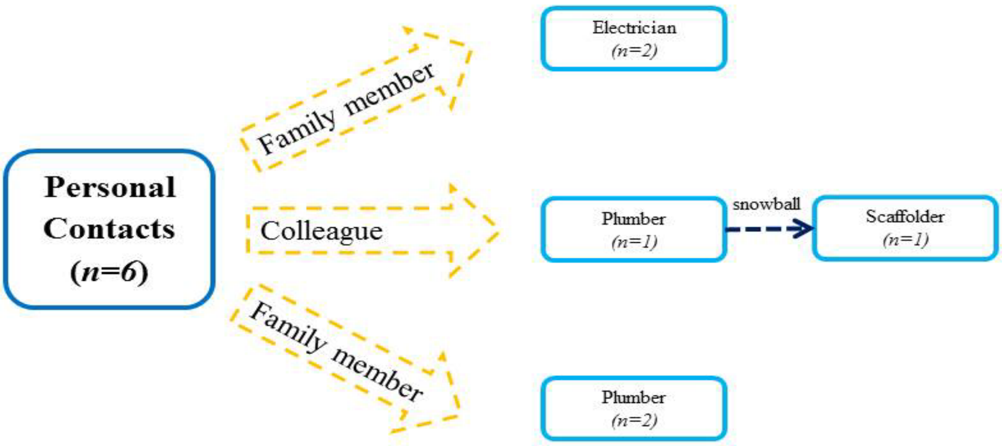


Figure 12: Personal contacts (n=6)



4.7.3 Demographics

Table 13 shows the age ranges of the workers in the sample and the average number of years spent in the industry. Table 14 shows the range of trades interviewed. To assist with analysis, trades with numbers of participants below ten were grouped together; bricklayers, scaffolders, labourers and ground workers were classified as 'outdoor trades' due to their work being mainly on the foundations of construction sites in the early phases of development. Painters/decorators, welders and plasterers were classified as 'other trades' due to their work being later on in the development of construction sites. 'Other trades' *(n=4)* were also removed from quantitative data analysis due to the small sample size.

Table 13: Age ranges of participants and their mean number of years spent in industry (n=80)

Age range	Frequency *(n)*	Mean number of years spent in industry
Under 25	13	5.3
25-34	12	8.2
35-49	25	21.3
50+	30	40.3

Table 14: Trades of participants

Trade	*n*
Plumber	22
Electrician	19
Carpenter/Joiner	14
Outdoor trades	21
Bricklayer	*7*
Scaffolder	*4*
Labourer/groundworker	*7*
Steel fixer	*3*
Other trades	4
Painter & decorator	*1*
Welder	*1*
Plasterer	*2*

4.7.4 Quantitative data: health

4.7.4.1 Nordic Musculoskeletal Questionnaire

Using the Nordic Musculoskeletal Questionnaire (NMQ), workers were asked about any aches, pains or discomfort they had experienced in the last 12 months (period prevalence) and seven days (point prevalence) in nine specific body areas. Where workers had confirmed symptoms in the previous 12 months, they were asked if they felt these were directly related to their work.

Findings from the questionnaire will be reported by comparing younger (under 50) and older (50 and over) workers, comparing trades, (plumbers, electricians, carpenters/joiners and outdoor trades) and comparing findings between the three organisations involved (domestic build company, civil engineering company and maintenance facility). Findings will be accompanied by graphical representations; to increase the clarity of graphical representations, age categories of 'under 25', '25-34' and '35-49' have been grouped as 'younger workers' (under 50) as there were no statistically significant findings between age categories '25-34' and '35-49'.

Musculoskeletal symptoms and age range

As shown in Figure 13, workers of all ages reported relatively high 12 month prevalence of musculoskeletal symptoms in all body areas. Older workers (50 and over) reported more symptoms in their knees compared to younger workers (under 25) suggesting that this may be an area of the body which is more seriously affected over time. This was a statistically significant association where 80% of workers aged 50 and over reported knee pain in comparison to 44% of workers under the age of 50 ($p \leq 0.05$). Workers aged 50 and over reported a higher 12 month prevalence of musculoskeletal symptoms in all but two body areas in comparison to younger workers. In addition to their knees, workers aged 50 and over reported a higher prevalence of musculoskeletal symptoms in the neck, elbows, wrists/hands, middle back, hips/thighs/buttocks and ankles/feet compared to workers aged under 50. Younger workers reported higher 12 month prevalence in their shoulders (42%) and middle back (28%) compared to older workers reporting 33% and 27% respectively but these differences were not significant.

Figure 13: Comparison of period prevalence (12 months) of musculoskeletal symptoms reported by workers aged under 50 and 50 and over (n=80)

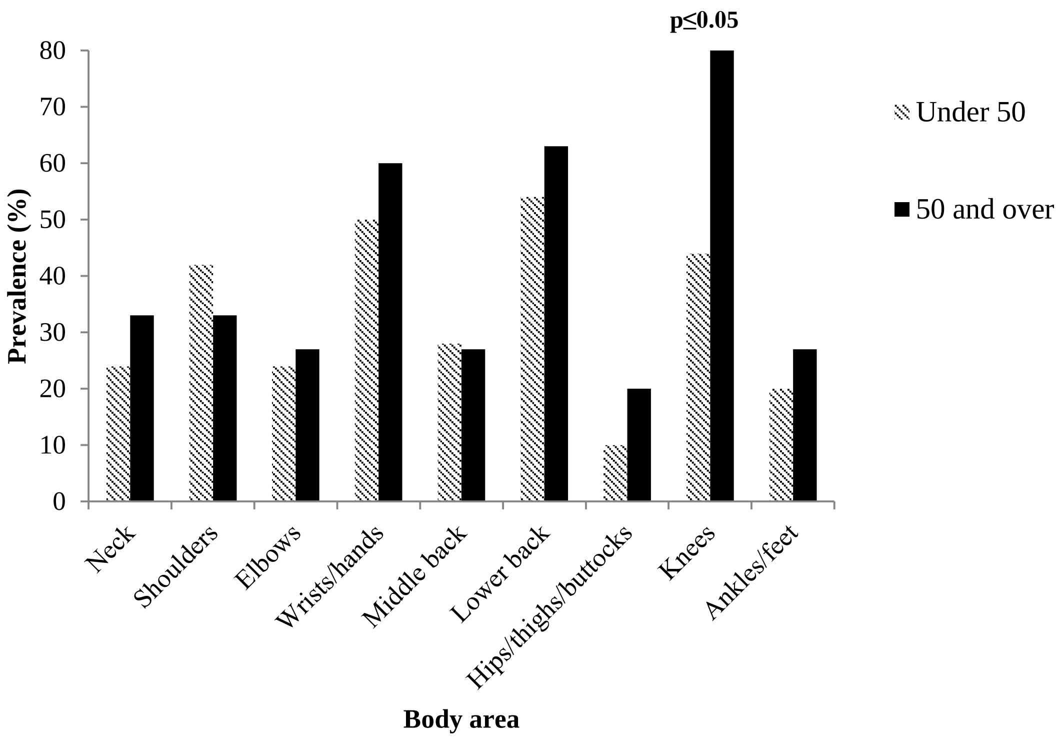
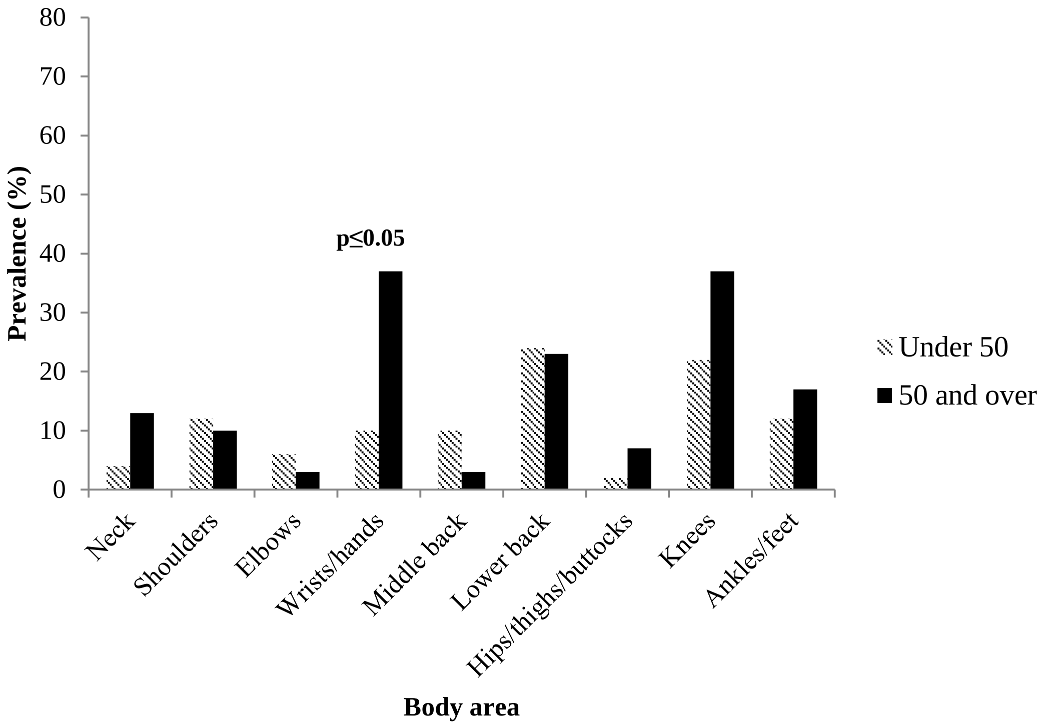


Figure 14: Comparison of point prevalence (7 days) of musculoskeletal symptoms reported by workers aged under 50 and 50 and over (n=80)



Overall there were fewer reports of seven day prevalence of musculoskeletal symptoms suggesting a lower prevalence of chronic symptoms (Figure 14). There was a statistically significant association between age and seven day prevalence of musculoskeletal symptoms in the wrists and hands; 37% of workers aged 50 and over reported symptoms in comparison to 10% of workers under the age of 50 ($p \leq 0.05$).

Interestingly there were more discrepancies between age groups for point prevalence compared to period prevalence; workers aged 50 and over reported more chronic symptoms than workers under 50 in five body areas (compared to seven body areas when reporting period prevalence). Older construction workers continued to report more symptoms in the neck (13%), wrists/hands (37%) hips/thighs/buttocks (7%), knees (37%) and ankles/feet (17%) whereas workers under 50 reported more symptoms in the shoulders (12%), elbows (6%), middle back (10%), and lower back (24%).

Workers who had reported musculoskeletal symptoms in the last 12 months were asked if they believed these were directly related to their work. For each specified area of the body, at least 30% of participants attributed their symptoms to their work, suggesting that across all ages and all body areas they perceived a risk of musculoskeletal symptoms. The highest prevalence of work-related symptoms for workers aged 50 and over was in the middle back and hips/thighs/buttocks, where all (100%) workers attributed their symptoms to their work. There was a statistically significant association between age and work-related musculoskeletal symptoms in the hips/thighs/buttocks ($p \leq 0.01$), with 100% of workers aged 50 and over attributing these aches and pains to work compared to 20% those aged under 50.

There were no significant differences between the length of time spent in construction and musculoskeletal symptoms in particular areas of the body apart from the knees, where the mean length of time in construction for those reporting musculoskeletal symptoms was 28.7 years in comparison to 17.2 years for those who reported no symptoms ($p \leq 0.05$) suggesting that the longer workers remain in the industry the higher the risk becomes for knee problems.

Musculoskeletal symptoms and trade

As previously stated, 'other trades' *(n=4)* were removed from this section of analysis due to the small sample size, leaving a sample size of *n=76*. Table 15 shows the 12 month prevalence of musculoskeletal symptoms reported by different trades.

Table 15: 12 month period prevalence (%) of musculoskeletal symptoms and trade

Trade Body area	Carpenter/joiner	Electrician	Plumber	Outdoor trades
Neck	43	37	27	14
Shoulders	29	42	36	43
Elbows	43	16	14	29
Wrists/hands	57	63	55	38
Middle back	21	32	23	33
Lower back	64	68	50	48
Hips/thighs/buttocks	21	21	9	10
Knees	50	68	68	52
Ankles/feet	36	26	14	24

As Figure 15 shows, electricians reported a particularly high period prevalence of musculoskeletal symptoms in the wrists/hands (63%), lower back (68%) and knees (68%). Knees and wrists/hands were also a problem area for plumbers (68% and 55% respectively) and elbows presented a high period prevalence for carpenters/joiners (43%) in comparison to other trades. 'Outdoor trades' reported high prevalence in the knees (52%) and shoulders (43%). There were no statistically significant associations between trade and 12 month prevalence of symptoms in any specific area of the body.

As shown in Figure 16, there was a statistically significant association between trade and musculoskeletal symptoms in the elbow; 75% of workers reporting seven day prevalence were carpenters/joiners ($p \leq 0.05$). Seven day prevalence of symptoms was the highest in all body areas for electricians apart from the elbows, in which no electricians reported symptoms and in the hips/thighs/buttock. Less carpenters/joiners reported lower back pain in the previous seven days, with the highest reported body areas being the wrists/hands (29%) and knees (29%). Plumbers reported a high point prevalence of symptoms in the knees and lower back (36% and 27% respectively) whereas 'outdoor trades' reported high prevalence in the shoulders, lower back and knees (all 14%). There were no other significant findings between trade and point prevalence of musculoskeletal disorders.

Figure 15: Comparison of period prevalence (12 months) of musculoskeletal symptoms reported by workers of different trades (n=76)

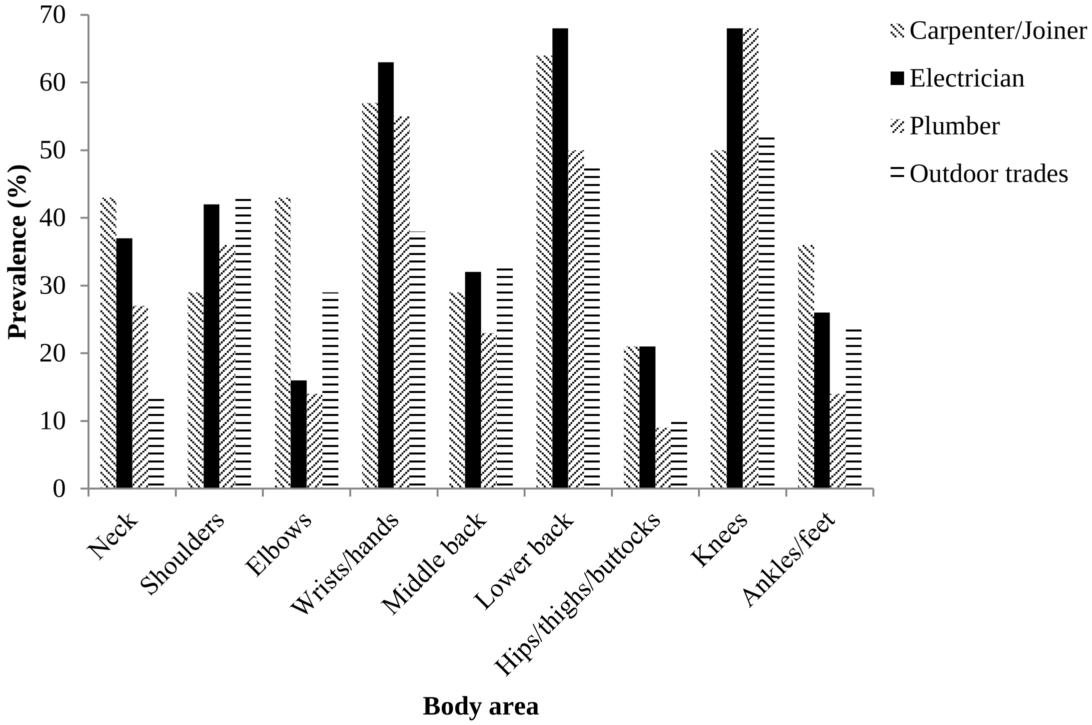
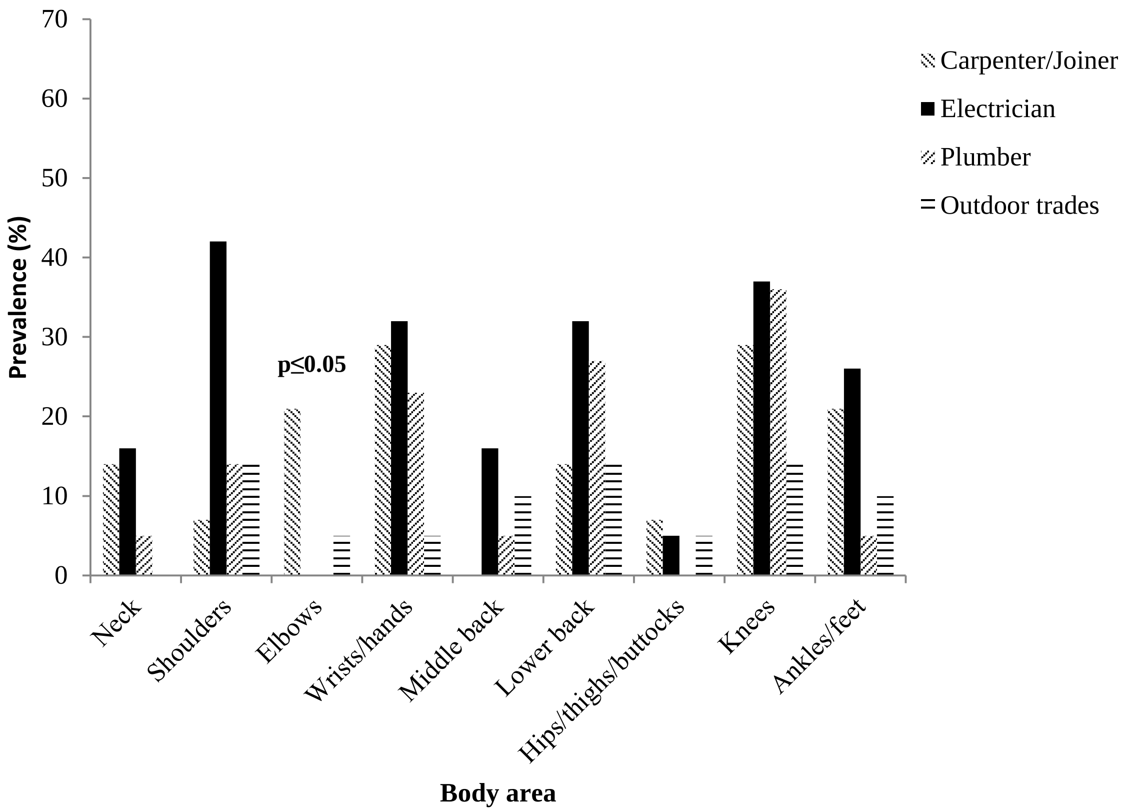


Figure 16: Comparison of point prevalence (7 days) of musculoskeletal symptoms reported by workers of different trades (n=76)



Workers who reported 12 month prevalence of musculoskeletal symptoms were asked if these were related to their work; of the carpenters and joiners who reported symptoms in their lower back and hips/thighs/buttocks, 100% attributed these to their work. 100% of plumbers attributed symptoms in their elbows and hips/thighs/buttocks to their work and 87% attributed their knee pain to their work. 85% of electricians attributed their lower back pain to their work. 100% of 'outdoor trades' who reported symptoms in the shoulders and lower back perceived these to be work-related. Symptoms in the ankles and the feet had little association to work for all trades. There were no statistically significant associations between work-related musculoskeletal symptoms and trade.

Musculoskeletal disorders and company

As previously stated, due to the small sample size of personal contacts (*n=6*) and them not belonging to one of the three organisations involved, these participants were excluded from quantitative data analysis.

Table 16 shows the trades from the three organisations: a maintenance facility with one static site and full-time workforce (*n=28*), a domestic build company based in London with multiple sites (5 were visited) (*n=30*) and a large international civil engineering and construction company with multiple sites (2 were visited) (*n=16*). Table 17 shows the age ranges of participants interviewed within each company.

Table 16: Trades of participants within each company

	Company	Maintenance facility (*n=28)*	Domestic build company (*n=30)*	Civil engineering company (*n=16)*
Trade	Carpenter/Joiner	5	3	6
	Electrician	8	8	1
	Plumber	15	4	0
	Outdoor trades	0	12	8
	Other trades	0	3	1

Table 17: Age ranges of participants within each company

	Company	Maintenance facility (*n=28)*	Domestic build company (*n=30)*	Civil engineering company (*n=16)*
Age range	Under 25	3	6	1
	25-34	1	7	4
	35-49	6	11	7
	50+	18	6	4

Workers from the maintenance facility reported the highest period prevalence of musculoskeletal symptoms in four out of nine body areas (Table 18); neck (29%), wrists/hands (69%), knees (75%) and ankles/feet (29%). There was a significant association between organisations and 12 month prevalence of musculoskeletal symptoms in the knees; 75% of workers from the maintenance facility reported knee pain in comparison to 57% in the domestic build company and 31% in the civil engineering company ($p \leq .05$). This could be expected due to the previous statistically significant findings of knee pain being associated with age range and a large proportion of workers in the maintenance facility being aged 50 or over.

There was a statistically significant association between organisation and seven day point prevalence of musculoskeletal symptoms in the wrists/hands ($p \leq 0.01$); 43% of workers from the maintenance facility reported symptoms compared to no workers from the civil engineering company (Table 19). There were no statistically significant associations between organisation and reports of any musculoskeletal symptoms being work related.

Table 18: Comparison of period prevalence (12 months) of musculoskeletal symptoms reported by workers in different organisations (n=74)

	Body area	Neck	Shoulders	Elbows	Wrists /hands	Middle back	Lower back	Hips/thighs /buttocks	Knees	Ankles/ feet
Organisation	Maintenance facility	29%	36%	14%	69%	29%	57%	7%	75%	29%
	Domestic build company	23%	37%	23%	50%	30%	53%	17%	57%	4%
	Civil engineering company	25%	50%	44%	31%	19%	63%	13%	31%	25%
									p≤0.05	

Table 19: Comparison of point prevalence (7 days) of musculoskeletal symptoms reported by workers in different organisations (n=74)

	Body area	Neck	Shoulders	Elbows	Wrists /hands	Middle back	Lower back	Hips/thighs /buttocks	Knees	Ankles/ feet
Organisation	Maintenance facility	11%	11%	4%	43%	4%	21%	4%	39%	21%
	Domestic build company	0%	3%	3%	7%	13%	37%	3%	20%	3%
	Civil engineering company	6%	19%	13%	0%	0%	25%	6%	19%	13%
					$p \leq 0.01$					

4.7.4.2 Work Ability Index

The Work Ability Index was used to collect workers' perceptions of their overall ability to work using a rating from 0 to 10 with 0 being completely unable to work and 10 being the best they have ever worked (Ilmarinen & Rantanen, 1999; Capanni et al., 2005).

There was a significant negative correlation between age range and work ability rating (rho=-0.280, n=80, $p \leq 0.05$), where workers under the age of 25 had an average rating of 9.2 compared to an average rating of 7.9 for workers aged 50 and over suggesting that work ability declines with age, albeit not at an alarming rate. An average rating of 7.9 for workers aged 50 and over is still considerably high considering a rating of 10 is 'the best they have ever worked'. There was also a significant negative correlation between length of time in construction and work ability rating (rho= -0.303, n=80, $p \leq 0.01$) suggesting that the longer workers spend in the industry the lower their perception of their work ability becomes. There were no statistically significant relationships between work ability ratings and trades although the highest average work ability rating was given by electricians (8.9) compared to the lowest which was given by plumbers (7.9).

4.7.4.3 Stage of Change Questionnaire

As previously stated, following the pilot study, the Stage of Change Questionnaire was removed as a specific data collection tool and instead was used as a facilitator for discussion. Workers were asked if they were concerned about developing aches and pains, to which 45% said they were. All 80 construction workers discussed changes that could be or had already been made to reduce the risks of aches and pains at work indicating that the entire sample was either in the contemplation or maintenance stages of change. Despite this, some workers initially felt they had not made any changes at all (although later going on to discuss changes such as bending and lifting properly and taking more care of themselves at work). These workers justified this by claiming that construction is an 'old school' industry where it is difficult to make changes, particularly within specific trades such as scaffolding and steel fixing, where working practices have remained the same for long periods of time.

"The job hasn't changed much in 40 years, I've still got the same equipment I use and I'm still doing the same job, that has not changed"

(LCFM24, plumber, 50+)

"I dunno how they could be made to be better to be honest with you, 'cos steel fixing is the thing that people have been looking at and looking at and there just seems to be no way around it"

(LB08, steel fixer, 50+)

"it's about the only trade which is still kind of medieval…scaffolding they can't seem to improve on because it's manual labour and it always will be"

(GW03, scaffolder, 35-49)

Another justification for not contemplating changes was that sites were perceived to be already good enough;

"I can't see anything to change really to make it safer, it's pretty good here - some are a lot worse than this"

(GW08, plumber, 50+)

"I think they're doing quite well. I don't think there's much more you can do"

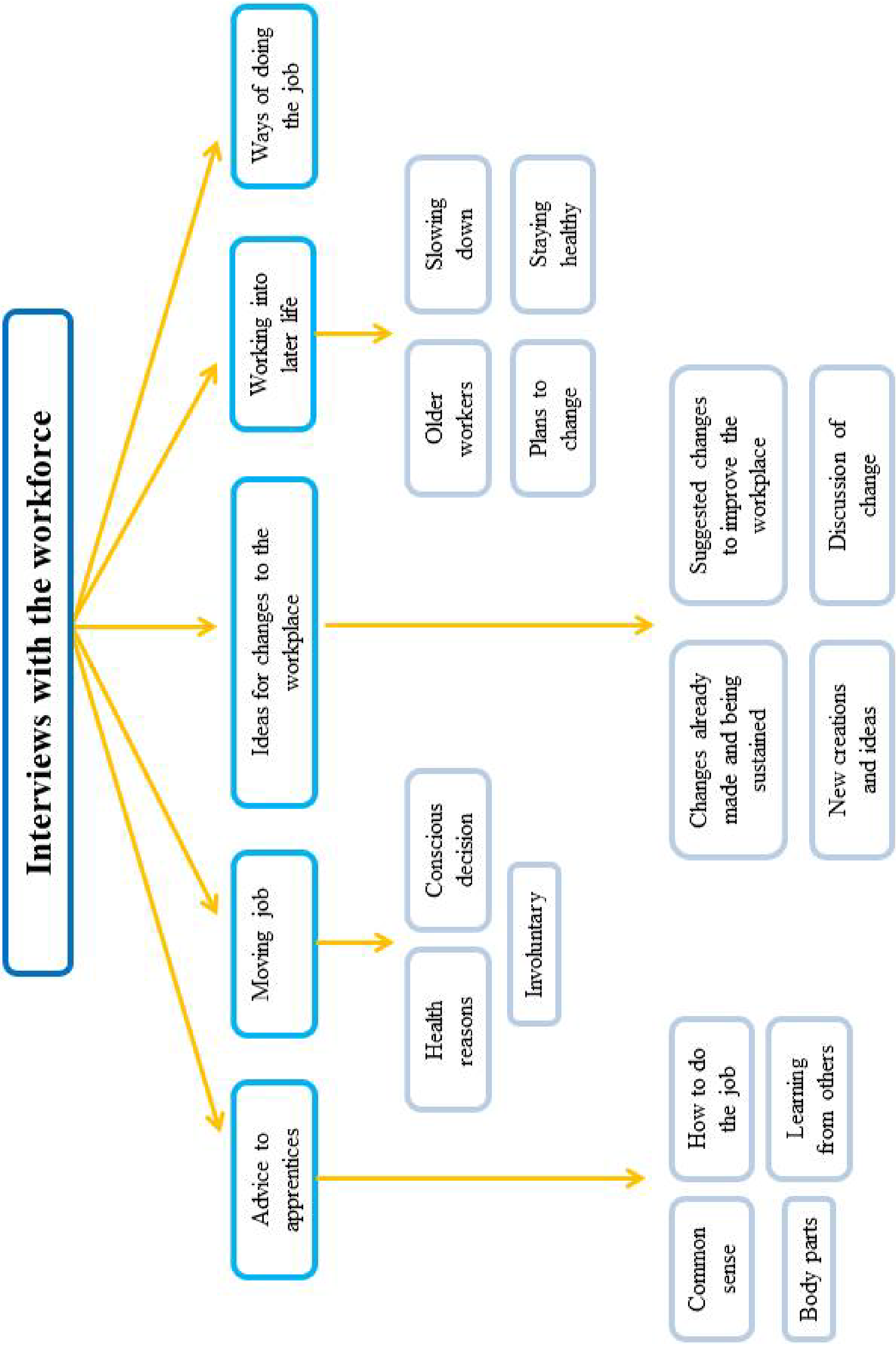
(GW05, electrician, 35-49)

4.7.5 Qualitative data: interviews

Results from the qualitative data collected will be reported in line with the interview schedule shown in Table 12. Results from the theme of 'their job' will be presented first, followed by 'ideas for changes to the workplace'. Participants were encouraged to discuss any thoughts they had within these themes as freely as they wished, with prompts and probes being used where necessary meaning that not all questions and prompts were asked to every participant (as shown in Table 12). The results of these two themes will be presented in terms of the thematic analysis carried out by the researcher.

Interview transcripts were analysed using a quasi-statistical approach which determines the importance of themes based on how often they are referred to within interviews. Based on these themes a template approach was also used which allows these key themes to be used as a template for further data analysis (Miller & Crabtree, 1992). Figure 17 illustrates an example of this analysis; from an initial read through of the interview transcripts, a number of main themes such as ‘advice to apprentices’ and ‘ideas’ were determined using a quasi-statistical approach. Using these themes as templates, further ‘sub-themes’ were identified such as ‘ideas and changes made’ and ‘suggested changes’ under the theme of ‘ideas’.

Figure 17: An example of thematic analysis of interviews with construction workers (n=80)



4.7.5.1 Their job

Participants were asked to describe an average day or week in their trade; this served as both an 'ice breaker' for participants at the start of the interview and also encouraged workers to fully immerse themselves in thinking about their tasks and what they do and think about when in the workplace. Table 20 shows the most commonly referred to tasks; several of these were trade specific such as plumbers referring to pipe work and electricians referring to wiring and pulling cables. Overall, lifting and manual handling tasks were the most frequently identified (61% of workers referring to these). Table 21 shows examples of trade specific tasks.

Table 20: Prevalence of workers referring to specific tasks

Task	Prevalence of workers (%)	Example
Lifting	61	*"I use my shoulder, I don't use a hod"* *"There's always gonna be a bit of lifting isn't there?"*
Materials	30	*"blockwork or brickwork"* *"you're dealing with iron pipes"* *"all my stuff comes in rolls of lead"*
Drilling and hammering	20	*"with your hammer, that's all day long sometimes"* *"drilling which is another"*
Working at heights (high or low)	18	*"do ventilation work in the ceiling"* *"on rooves and stuff"* *"under a floor"*

Table 21: Examples of trade specific tasks

Trade	Task
Carpenter/Joiner	Putting up formwork for concrete pours Shuttering
Electrician	Wiring Running cables Pulling in cables Stripping armoured cable
Plumber	Fitting bathrooms and boilers Pipework Installing rainwater pipes Water and gas mains
Plasterer	Plastering Defects
Scaffolder	Erect scaffolding Adapt scaffolding

4.7.5.2 Work environment

When discussing their jobs, 73% of participants (*n*=58) made 224 references about their working environment in various contexts including the weather (53%, 118 references), working in small spaces (11%, 45 references) and work areas (17%, 37 references).

The weather was raised by over half the workers (53%) and was one of the main problems in relation to the work environment. Problems were related to both when it was too hot and too cold, particularly when it is teamed with heavy manual work and poorly designed protective clothing;

> *"It's as bad working in 30 plus degrees of heat as it is working at freezing"*
>
> (BR01, bricklayer, 50+)

The second most common problem related to the work environment was working in small spaces (11%). Working in small spaces was seen as an un-avoidable but temporary issue, with workers having to slide under pipes and floorboards to reach particular areas. It was often considered to be a flaw in the design of the building and participants attributed this to a lack of consideration to maintenance workers.

27% of participants made 37 references about their work areas such as wanting them to be clean and tidy so that they not only felt safe but also organised. Workers made sure their work area was clear so that they would avoid tripping hazards and conversely other workers spoke about messy work areas being safe as long as they knew where they could step without tripping. A suggestion from one worker was to clean the walls of the work areas, particularly in their current work place as it was underground;

> *"for a job like this…just washed the walls…you're getting rid of it, fungus, just blast it with water…because if you're working…there's a bit of vibration, stuff is falling"*
>
> (LB09, carpenter, 35-49)

Surprisingly, dust and ventilation was raised as an environmental issue by only 8% of the workers (18 references), over a third of whom (38%) were carpenters/joiners;

> *"the dust in unbelievable, that's my biggest, biggest pet hate"*
>
> (CL01, carpenter, 35-49)

The main issue with this was the lack of ventilation, as these workers were in tunnels, which caused the dust to build up. Workers were concerned about the effect this would be having on their health, both in the short and long term with asthma, breathing difficulties, problems with vision and lung problems later in life. In the majority of cases, workers perceived that very little could be done in relation to reducing the dust and having more ventilation, due to the stage of build on site meaning that the windows were not yet able to be opened.

Other issues raised regarding the work environment (by less than 10% of workers) were the lack of natural light, particularly for electricians who were working to install lighting, joists in loft spaces and the effect these case have on workers' knees and also the dangers of asbestos in older buildings and the need to check for this before beginning work.

4.7.5.3 Personal protective equipment

Workers were asked about how they protected themselves at work; 75 participants (94%) made 629 references to personal protective equipment (PPE) during the interviews and Table 22 shows the main types of PPE discussed. Depending on who the workers were employed by, PPE was either provided by the employer or was the responsibility of the individual. Various types of PPE were referenced, with particular site regulations and the type of job dictating how much and how often PPE was worn. Equipment was discussed both positively and negatively i.e. workers had varied opinions on whether the equipment was helpful, a hindrance or needed improving.

Table 22: References to personal protective equipment

PPE	Prevalence of workers (%)	Number of references
Gloves	58	122
Knee pads	58	110
Goggles	51	99
Hard hat	48	59
Boots	38	43
Dust mask	28	47
Ear defenders	28	30
High visibility jacket	24	25
Improvements to PPE	9	13
Overalls	6	6
Harness	8	14
Wearing multiple PPE	16	16
Long sleeves	5	6
Miscellaneous	34	40

By far the most common negative reference to PPE was related to the design, such as knee pads being too tight or not staying in the right place, high visibility jackets being too hot because of the material, goggles steaming up when worn with a dust mask or in wet weather, boots not being very comfortable or the material of protective gloves not being resistant enough for tasks, particularly for scaffolders, where there is a lot of manual handling of steel pipework. Some electricians felt that the material of the gloves was not thin enough to allow work with small intricate screws, causing them to cut the tops of the fingers off, whereas other electricians simply removed the gloves altogether. Other workers complained about the lack of waterproofing for gloves, meaning that working in wet weather became extremely difficult.

> *"with these high-vis, because they're nylon I get really hot"*
>
> (GW08, plumber, 50 and over)

> *"they [goggles] do steam up, especially on a wet day when you're sweating…the next thing they're up on your forehead and the next thing, you're cutting and the next thing sparks go into your eyes"*
>
> (CL01, carpenter, 35-49)

> *"once the gloves get wet that's it, you're done, the gloves are done for the day"*
>
> (BR11, plasterer, under 25)

“we do so much manual labour we get holes in them throughout the day, scaffolders, you’re passing things through yours hands all day...I don’t think they’ve bought out a glove that can withstand the material”

(GW03, scaffolder,35-49)

Workers felt that PPE was very much reliant on ‘common sense’ and claimed that in some situations it was not needed despite their employers enforcing such regulations. Examples of these situations included not using knee pads if workers were only going to be on their knees for a short period of time, not wearing a hard hat on the rooves of buildings as they felt there were no overhead risks, and concerning drilling, one plumber commented:

“there are certain times where you just think I could just do that job now, without…some glasses…you just use your head and think I’ll just turn my head in the opposite direction while I’m doing it, it is just common sense at the end of the day but like you say, it can catch you out”

(LCFM21, plumber, 35-49)

Out of the 41 workers who spoke about goggles, 41% of these noted the issue of goggles steaming up and compromising their vision. Almost half of these workers (47%) came from one site within the civil engineering company where there had been several cases of goggles and glasses becoming steamed up in the rain, which according to many workers was a more serious safety hazard than not wearing goggles at all. This had caused noticeable tension in this workforce and many of the interviewees had raised this issue with management, such that it was decided that in “wet weather” workers were permitted to remove their goggles, which otherwise had to be worn at all times on site. However, problems still remained regarding when it was “wet enough” to remove the goggles;

“there’s been an issue at the minute with goggles in the rain…we’ve had to sign on to say if the rain is heavy then you can take your glasses off, but then who determines whether the rain is heavy?”

(CW04, groundworker, 25-34)

“they say you’re allowed to take them off when it’s raining but it don't have to be raining for them to steam up, if you’re working hard and you’re getting a bit hot then they steam up”

(CW06, bricklayer, 25-34)

Solutions were suggested to either solve or at the very least alleviate these problems; these included using ‘all-in-one’ breathing masks and goggles, using a steam resistant material or removing the mandatory rule of goggles on site. One worker raised the issue of the low levels of breathability in high visibility jackets; their suggested solution was to use a different material for the jackets such as gortex, although the cost of this was considered to be too high.

Other topics surrounding PPE included three workers speaking about novel uses for PPE or equipment to help with their health and wellbeing at work including; wearing weight lifting belts to provide support during manual handling, using ‘hop-ups’ as stools to sit on when doing lower level work, a new hard hat with a balaclava attached to the inside for warmth and using hand warmers inside gloves during cold weather. A small number of workers also discussed regulations and the mandatory nature of PPE which may have also contributed to the lower number of references to compulsory PPE such as hard hats, steel toe cap boots and high visibility jackets as these become ‘subconscious’ items of PPE which were likened to ‘putting your seatbelt on in a car’.

4.7.5.4 Working into later life and ageing in construction

83% of workers (*n=66*) made comments about working into later life; generally younger workers spoke about not wanting to stay in heavy manual construction as a career, older workers spoke about their intentions of slowing down their pace of work and workers of all ages reported making conscious decisions to remain fit and healthy so that they could continue working into later life. Discussion about working into later life was not limited to the older cohort of construction workers; younger workers spoke openly about their plans to move away from manual work so that they could earn more money and look after their health;

> *"when I'm 50 I won't be doing that…I won't be working on site, I'll have my own business"*
>
> (BR03, plumber, under 25)

29% of workers spoke about making plans to change the way they work; 26% of these were aged under 25 and 35% were aged 50 and over. Three workers (two aged under 25) spoke about starting their own business, whilst 5 workers (two aged under 25, two aged 25-34 and one aged 35-49) spoke about finding a way out of heavy manual labour. One worker (under 25, electrician) spoke about how he had recently moved from heavy manual construction site work to slower paced maintenance work and as a result he reported feeling both physically and mentally healthier. It is encouraging that in the sample, workers of all ages spoke about consciously making an effort to keep fit and healthy outside of work so that they were able to perform well in their job. Strategies for this included attending the gym, playing recreational sport and taking vitamin supplements such as cod liver oil and garlic capsules.

Older workers were held in particularly high regard by younger workers as they were thought of as having more knowledge and better ideas as a result of being in the industry for longer. Workers appreciated older workers because they felt they could learn a lot from them;

> *"I like working with older workers…I ask a lot of questions and they've been through it all…if you work with an older guy he will tell you the ins and outs of how to do it better or safer"*
>
> (CL01, carpenter, 35-49)

However there were also some negative comments such as older workers being slower, less able to lift heavy loads and not being as 'clued up' (sic.) as they were when they were young. Many older workers also spoke about how they did not appreciate having to wear all of the PPE as per new regulations, as they reported they 'never had to wear it all when they started work' and it has 'never done them any harm before' compared to younger workers who are taught from their first day of training that PPE is mandatory.

> *“older men are a wee bit past it…they’re maybe not as speedy, maybe not as clued on as they were back 15, 20 years previous”*
>
> (CL01, carpenter, 35-49)

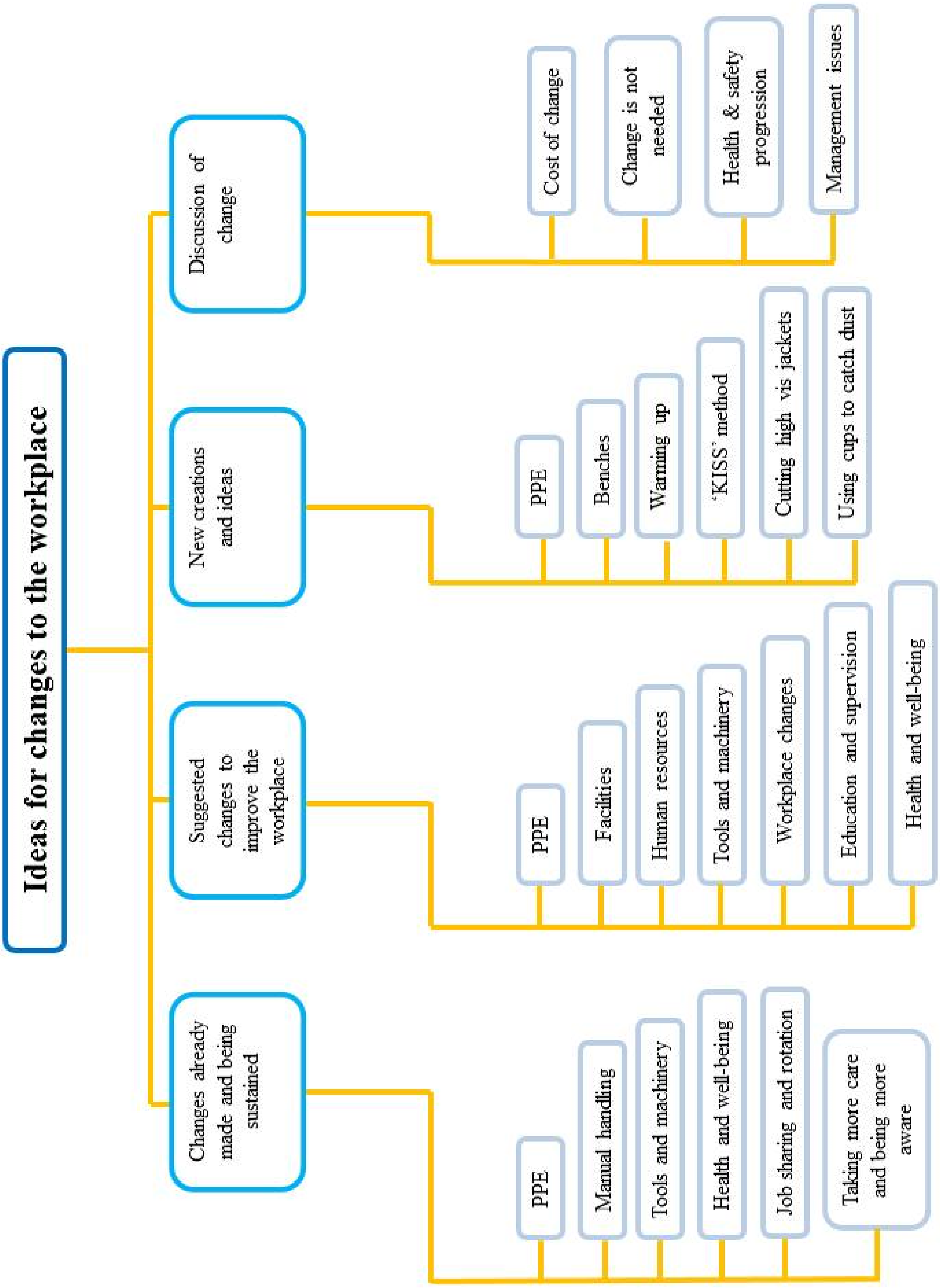
> *“yeh [the older workers don't wear masks] they just don't care really”*
>
> (K03, carpenter, under 25)

4.7.5.5 Ideas for changes to the workplace

Workers were asked if they had any ideas or had already made any changes to the way they work or to their workplace, in order to improve their health and wellbeing at work and to make their jobs safer or easier. It is encouraging that all 80 workers discussed ideas for changes to the workplace; these responses were thematically coded for the research. Figure 18 illustrates the four themes emerging from analysis of the interview transcripts; ‘changes already made and being sustained’, ‘suggested changes to improve the workplace’, ‘new creations and ideas’ and ‘discussion of change’. General discussion also took place around the notion of change, including how change was not necessary, whether suggested changes would be too expensive and how the construction industry has already changed over the course of several years.

As previously discussed, thematic analysis was undertaken by the researcher using a quasi-statistical and template approach. Figure 18 shows the initial them of ‘ideas for changes to the workplace’ which was identified through the prevalence of references throughout interview transcripts. Using this as a template for further analysis, sub-themes were created followed by more specific sub-themes.

Figure 18: An example of thematic analysis for changes to the workplace



Changes already made and being sustained

A total of 423 references were coded under the theme of 'changes already made and being sustained' by workers; there were several 'repeated regularities' which were clearly considered to be important by the workers. The most frequently reported changes are described below.

95% of workers spoke about changes they had already made to improve their jobs, workplaces and health and wellbeing at work. Table 23 shows the areas in which changes were made in addition to the number of workers who had made changes and the number of references made within each area. The four workers who had not already made changes were aged under 25, 35-49 and two aged 50 and over so there were no clear age patterns; there were also no particular reasons given for the lack of changes made.

Table 23: Changes that had already been made by workers

Area of change	Participants making references (%)	Number of references
PPE	53	70
Tools and machinery	51	75
Health and wellbeing	37	60
Manual handling	33	40
Job sharing and rotation	25	23
Taking more care and being more aware	20	16
Experience and learning	20	19
Miscellaneous	24	24
Clothing	17	16
Breaks and rests	16	18
Preparation and organisation	14	13
Toolbox talks	13	14
Environment	12	12
Moving job	10	14
Comfort	9	9

PPE was discussed by the highest number of participants, with 50% of workers making 70 references. Changes included buying new equipment at the beginning of a new job and cutting the fingertips off gloves so that intricate tasks such as using small nails and screws could be completed more easily. It became clear that younger workers (under 25 and also 25-34) took wearing PPE for granted whereas older workers cited ‘simply using’ their PPE now as a change, as due to changes in safety regulations equipment has become a site necessity rather than a choice.

> *“different boots, new job, new boots, that’s the way we work”*
>
> (BR10, bricklayer, 35-49)

> *“when I started 22 years ago there was very little PPE…you wouldn't have safety boots, you wouldn’t have glasses, no helmets, no nothing”*
>
> (CW11, electrician, 35-49)

> *“it were a rarity you got overalls, so the PPE side of things progressed, it’s unbelievable now…but obviously it’s for a reason”*
>
> (PC04, scaffolder, 35-49)

Half of the workers (51%) had made changes related to tools and machinery including specific tools and assistive equipment such as jacks, which allow for the easy rolling out of cables, using dampers on handles of heavy machinery in order to minimise the risk of hand arm vibration syndrome and the use of cordless tools.

> *“anything to make our lives easier, we use cable jacks, they do help a lot”*
>
> (BR06, electrician, 25-34)

> *“there’s all kinds of easier tools”*
>
> (GW13, bricklayer, 50+)

> *“we don't use electrical drills like we used to, everything’s a battery drill now, more portable, easier, lighter, safer on construction sites as well”*
>
> (LCFM02, electrician, 35-49)

Many workers (37%) discussed changes they had made to consciously maintain their health and wellbeing both inside and outside of work. As previously reported, older workers had made dietary changes such as taking supplements whereas younger workers took an interest in playing sports and attending gyms to keep fit. Other changes included workers doing stretches at home, having massages or physiotherapy, eating healthily and having an active social life.

"I love the gym, I'm in the gym all the time I'm keeping myself nice and healthy"

(BR02, scaffolder , 35-49)

"I take cod liver oil as well, I take aspirin as well"

(CW01, joiner, 50+)

"I've got a good girlfriend so she normally gives me a back massage"

(BR08, plasterer, 25-34)

"you do have a little stretch…you do go through a little routine and that of going to bed…straighten myself up, that sort of thing, you have to do it in my opinion, it helps"

(BR10, bricklayer, 35-49)

Many workers (33%) discussed changes to their manual handling behaviour, including consciously following good practice such as bending their knees when lifting, taking their time over strenuous jobs, asking for help if a load was too heavy or waiting for lifting machinery to become available. Machinery was viewed by many workers as a way of saving a considerable amount of man power.

"I make sure I lift properly, 'cos I'm still young and I wanna be doing this for a long time"

(PC06, plumber, under 25)

"you just have someone to help you out, try not to carry too much, try and keep it down to the minimum you can carry"

(LCFM28, plumber, 50+)

Other changes that had been made and were being maintained by workers included regular job sharing, rotation of particular jobs such as drilling and using heavy machinery, taking more care at work and having more awareness of health and safety hazards. There were 19 references from 20% of workers about learning from others' experience; younger workers spoke about listening to older workers and learning from their experiences in their trades, similarly, older workers spoke about passing down their knowledge to younger workers. There were also 24 miscellaneous references which were not repeated frequently enough to form their own theme, such as workers taking regular breaks, keeping themselves covered in cold weather to avoid aches and pains, getting themselves comfortable before beginning jobs in tight and awkward positions and making their environment as pleasant and safe as possible by keeping it tidy, light and well ventilated. 13% of workers made 14 references to tool box talks, with some reporting that they were attending more talks than they had in the past, alongside attending health and safety courses. Older workers in the maintenance facility in particular, mentioned that they had consciously moved to a slower paced environment, from heavy work on construction sites in order to sustain their work ability.

> *"I listen to my uncles and my father…they've explained all this to me down through the years…now that I'm getting a wee bit older and a wee bit wiser I think oh aye, he told me not to do that and he told me not to do this"*
>
> (CL01, carpenter, 35-49)

> *"I think you would definitely tell them little trade secrets"*
>
> (CW07, foreman, 25-34)

> *"that's where you learn everything from, other people"*
>
> (GW04, carpenter, 35-49)

Some changes that came up in the interviews were not instigated by the workers themselves but by the industry. An example is the introduction of 'trigger times' on heavy vibrating hand tools whereby each tool has an individual 'trigger time' which must not be exceeded; these times had been put in place in order to reduce the symptoms of hand arm vibration such as vibration white finger. Workers are required to fill out sheets at the end of the day stating how long they have spent on these tools. More sophisticated tools have the trigger times displayed on a meter, with green, amber and red for the length of time the tool can be used for. However, one worker spoke frankly about the manual time report sheets and said that workers often exceed their trigger times in order to get the job finished sooner, leading to workers reporting incorrect timings.

Suggested changes to improve the workplace

Most workers were also very willing to suggest changes to the workplace, workforce and industry as a whole. These came from their experience on other sites or ideas they had heard about from colleagues or ones they had thought about but were not yet available. The majority of construction workers (*n=64*, 80%) suggested 265 changes, including 'repeated regularities' which were coded into 8 sub-themes. The most frequently referenced suggestions from workers are reported in Table 24.

Table 24: Most frequently reported suggestions for changes to improve the workplace

Area of change	Participants making references (%)	Number of references
PPE	40	46
Education and supervision	34	43
Human resources	33	51
Workplace	33	39
Tools, machinery and materials	23	25
Facilities	22	26
Miscellaneous	19	18
Health and wellbeing	16	17

As already discussed in Section 4.7.5.3 (Personal Protective Equipment), workers had a lot of issues with the design of their equipment such as goggles steaming up, gloves being made from awkward materials and boots not being very comfortable. Therefore unsurprisingly, the most frequently referenced theme under 'suggested changes' was, once again, PPE with 40% of workers proposing ideas for changes related to this. There were no obvious patterns related to age and suggestions related to PPE. Suggestions to improve the situation of goggles becoming steamed up included 'getting rid of goggles altogether', improving the design of them perhaps with more 'breathing holes' to prevent steam building up which compromises vision or to produce a more stringent set of guidelines for exactly which circumstances the goggles should be worn in. One site within the civil engineering company had allowed workers to remove their goggles in wet weather to eliminate the risk of compromised vision, however there was still uncertainty as to when it was "wet enough" to take the goggles off. A small number of workers also mentioned the difficulties with having to wear prescription glasses underneath safety goggles.

> *"goggles, glasses, that's a bit of a sticky one, if they're gonna make you wear glasses, I wear glasses anyway they've got to supply you with prescription glasses, not these over-glasses because all they do…makes your peripheral vision non-existent"*

(CW10, carpenter, 35-49)

Other suggestions to improve PPE included glove material itself as issues included the gloves not being waterproof or not strong enough to withstand the constant handling of steel works. One worker (electrician, under 25) suggested introducing padding in particular areas of the gloves, such as the top of the palm, below the fingers and the heel of the hand, as the gloves often rub on these parts of the hand and cause aches and pains. Three workers also had specific suggestions about the footwear required on site; they felt that being in a job which required a lot of walking around site and being on their feet all day required more expensive and comfortable boots. Suggestions to improve the situation included offering workers a tax rebate or refunded percentage if they bought good quality boots;

> *"if you go for the newer version you have like more padding but the dearer version is £80/£100/£150 but if you had some sort of rebate back, off the tax man…you have your receipt there…if I get 30% back, you know it would help"*

(CL01, carpenter, 35-49)

> *"I get through 4-5 pairs of boots a year whereas most other trades probably only get through one or two"*

(GW03, scaffolder , 35-49)

Further suggested changes included better designs of dust masks to ensure they do not let any particles in and better design of knee pads which workers felt did not provide adequate protection because they were not thick enough, or the attachments around the legs were too tight, leading to their circulation being cut off.

Many workers were interested in improving education and supervision and 34% made suggestions to change this. These workers wanted to see a higher level of supervision, particularly of younger construction workers who were new on site; unsurprisingly most of these suggestions came from older workers who felt that younger workers were lacking in experience which could lead to them engaging in less safe behaviours on site. Workers also wanted higher levels of education and knowledge transfer within their workforces, for example more toolbox talks, making toolbox talks more relevant, having interactive discussions with video clips and having older workers speak about their own personal experiences. One worker (electrician, 35-49) felt strongly that workers in the construction industry have an embedded culture of working hard and fast within a short time period in order to earn as much money as possible, which he believed resulted in serious health issues later on in life and majorly contributed to older workers having to leave the industry early.

> *"it's a cultural thing, unless you change people's cultural perceptions on what they should be doing at work they'll just carry on working"*
>
> (GW12, electrician, 35-49)

> *"you get someone reading off a piece of paper, I think if it was a short clip rather than reading…you take it in more"*
>
> (CW04, groundworker, 25-34)

Several workers (33%) made 51 references about the lack of human resources support in the construction industry, which they felt led to some workers feeling undervalued and not appreciated by their company. Suggestions to improve this included an increase in wages, more holiday time and having more staff events put on for workers. Wages and pay were raised as a grievance by several workers, particularly in light of much of construction work being 'on price'; with workers being paid more if they finish the job before the allocated time meaning that often 'healthy' working behaviours are lost in favour of quicker, perhaps less safe methods of working. One scaffolder felt that their trade should be paid more due to the dangerous nature of the job and a second worker also highlighted that construction is different to many others as there is no 'golden handshake'.

> *"there's no incentive, if I finished here at 65 I'd walk out the gate with nothing, yet a miner…would be walking out with a £50,000 handshake"*
>
> (CW09, joiner, 35-49)

Within the theme of human resources, workers from the maintenance facility also expressed their need for apprentices to be taken on board as they felt they had no-one to pass their knowledge and experience down to when they retire;

> *"there's no apprentices coming through…we could do with one here…one of our lads that retired a couple of years ago, he was knowledgeable but there was nobody there to pass it on to"*
>
> (LCFM09, joiner, 50+)

> *"for a start you've got to have an apprentice…that's the be all and end all because once they're taken on board, you'll show them*
>
> (LCFM10, joiner, 50+)

> *"in the last five years of your working life you should be given an apprentice to show the ropes to"*
>
> (LCFM12, joiner, 50+)

Some workers (33%) made 39 suggested changes to their workplaces and work environments. Older workers in particular made suggestions such as cleaning the workplace to reduce dust inhalation and general tidiness of work areas. Other suggestions included better levels of ventilation and lighting. 23% of workers made 25 suggested changes to tools and machinery such as making them lighter, cordless or increasing the availability of tools on site as it was felt that by 'off-hiring' tools jobs were delayed. 22% of workers suggested improvements to facilities available one site such as more hot water, more toilet rolls, better canteen facilities and cleaner, larger changing rooms and welfare facilities. Finally, some workers felt that there should be more incentives and discounts for health and wellbeing, such as occupational health therapists, physiotherapists and discounted gym memberships. This was particularly mentioned by the workforce of the maintenance facility, as they had previously been given free membership to their on-site gym; however this benefit had been removed due to cost cutting strategies.

New creations and ideas

Almost a third of workers (31%, *n=25*) made 40 references to new ideas which they believed were novel and unique to them, including ways of going about their work to make it easier or more comfortable and to save strain on their bodies. Workers of all ages came up with these novel ideas and ways to improve their health and wellbeing at work. Older workers had more ideas in comparison to younger workers (4 workers under 25 compared to 8 workers aged 50 and over) suggesting that workers who had spent longer in the industry and had more experience were more able to think of novel solutions to improve their jobs and workplaces. Nearly half of these (44%) were related to PPE including new colours for high visibility jackets (orange instead of yellow) to make them stand out more, cutting high visibility jackets so that they don't snag on equipment and keeping their gloves inside their hard hat so that their PPE is always kept together. 16% of workers spoke about making up their own benches at work to ensure they had a sturdy surface on which to cut materials at the most suitable height for them. Other specific ideas from individual workers included putting a plastic cup around a drill to catch falling dust from a ceiling; making up a portable box to hold small fittings, nails and screws; putting a head torch on under a hard hat as the elasticated band means that it does not stay in top of the hat very well; having a tray around the top of step ladders to hold tools and materials; and warming up, cooling down and stretching before strenuous tasks to minimise the risk of aches and pains. Table 25 shows further examples of new ideas and Table 26 shows a full list of the 40 references made by workers, including their age and trade.

Table 25: Further examples of new creations and ideas

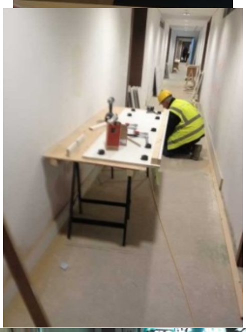
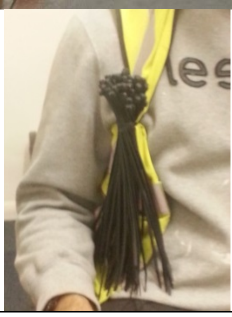
Image	Description	Worker
	Homemade knee pad made from lagging and duct tape	Electrician Under 25
	Balaclava attached to the inside of a hard hat	Foreman 25-34
	Workers making up their own benches so they have a sturdy surface to cut materials on, at a specific height for them	Carpenter 35-49
	Using a tool bag as a back support to prevent bad posture and aches and pains	Electrician Under 25
	Attaching cable ties to a high visibility jacket so that they are easily accessible at the top of step ladders	Electrician Under 25

Table 26: Full list of 40 references to new ideas by workers (n=25)

Idea	Worker
Making up a knee pad	Plumber, Under 25
A tray around the top of steps to hold a drill	
Marking places where all clips are going before starting a job	
Putting a cup around the drill so it catches the dust	Electrician, 25-34
Warm up and cool down before and after strenuous jobs	Plasterer, 25-34
Making up a bench	Joiner, 50+
Making jigs to hold work pieces	
The ‘KISS’ method “keep it simple stupid”	
Making up a bench	Joiner, 50+
Making up nail boxes for nails and small fittings	
Cut the high vis jackets to stop them catching on equipment	
Orange should be a new colour for high vis jackets	Groundworker, 35-49
Balaclavas attached to the inside of hard hats	Foreman, 25-34
Making up a bench	Joiner, 35-49
Weight lifting belt for support and to keep the back warm	Carpenter, 35-49
Using a big cushion as a knee pad	Electrician, 35-49
Having an on-site health professional	
Magnetic band on the wrist to stop knuckles getting tight	Bricklayer, 50+
Putting gloves in the webbing of a hard hat	
Wearing a spanner in the most comfortable place on belt	Scaffolder, 35-49
Making up a knee pad	Carpenter, 35-49
Hole in bench to hold saw eliminating bending	
Making up a bench	
Wearing head torch on head under hat	Electrician, 35-49
Making up a jack out of materials available	Electrician, 25-34
Using tool bag as a back support for lower level work	Electrician, under 25
Blowing dust away when drilling overhead	
Tying cable ties to the lapel of high vis jackets	Electrician, under 25
Digging screws needed in the plasterboard at top of ladder	
Making up a knee pad	
Having a mini-bus on site to take workers to A&E if needed	Labourer, 50+
Making up a knee pad	Electrician, under 25
Use beeswax to soften wood when drilling	Joiner, 50+
Using a cushion for a knee pad	Plumber, 50+
Rubber matting on the floor of the voids (need to crawl)	
Putting in extra valves when needed on a job rather than later	Plumber, 50+
Making up a knee pad	Plumber, 50+
Homemade pole for changing toilet seats	Plumber, 35-49
Want a tool to cut pipe without having to isolate water supply	
Putting dust masks into webbing of hard hat	Plumber, 50+

Discussion of change

The majority of these trades' workers (81%) took part in wider discussion around their ideas, including the costs that could potentially be involved when making changes, problems with communication and feedback from management and the progression of health and safety over previous decades. Also included within this theme were references from workers who dismissed change, both positively by saying that there was no need for change as everything on site was good enough and also negatively with workers stating that change would not be accommodated or tolerated in the industry or within their workplace or workforce.

> *"you're never gonna change it, 'cos that's just the nature of the way the job is"*
>
> (BR01, bricklayer, 50+)

> *"it's just years of experience to find the easy ways"*
>
> (CW08, welder, 35-49)

> *"there's not a way round it unless you just wrap everybody up in cotton wool"*
>
> (CW10, carpenter, 35-49)

One barrier to change mentioned by a small number of workers around improving the health and wellbeing of the workforce was that change is down to the individual, therefore making changes to the workplace or workforce as a whole would be very difficult, if not impossible.

> *"some people on site they have common sense, but some people on the site, they will never understand…it's down to the individual"*
>
> (GW04, carpenter, 35-49)

A further point raised by a small number of workers was that specific conscious changes were not needed. It was perceived that it is often the case that experience and knowledge in a workers' trade will automatically encourage healthy changes in behaviour, without workers needing to actively consider these. It is interesting that they believed their bodies adapted and that they became more aware of the consequences of their actions at work as they became more experienced.

"if you keep doing it, your body adapts to it…at first it hurts but then your body gets used to it"

(BR05, electrician, under 25)

"it's always been like that, when I started working in '96, nothing's got easier, we've always adapted things"

(CW01, joiner, 50+)

4.8 Discussion

This chapter has described an interview study to capture workers' views on health and wellbeing at work and explored and captured their ideas to facilitate healthy working behaviours for longer working lives. In this section, the most prominent and important findings in relation to the objectives will be discussed in addition to previous research studies in this area, followed by the limitations of this study and the conclusions.

Workers of all ages reported a high period prevalence of musculoskeletal symptoms in all areas of the body, supporting the already well-documented premise that construction work requires tough heavy manual labour that can take its toll on ageing workers (Arndt et al., 2005; Oude Hengel et al., 2012). Unsurprisingly, workers aged 50 and over reported a slightly higher prevalence of symptoms in comparison to younger workers, which also supports previous research that ageing workers can be more severely affected by the heavy nature of the industry (Brenner & Ahern, 2000; Deacon et al., 2005). Lemasters et al., (1998) found that carpenters with more than 20 years' experience had statistically more musculoskeletal disorders than a similar group with less than 10 years' experience.

The highest reported body area for musculoskeletal symptoms was the knees, with statistically significant associations being found for both age range and length of time spent in construction, with older workers and those who had spent longer in the industry experiencing more symptoms compared to younger workers, supporting findings of previous research (Reid et al., 2001; Holmström & Engholm, 2003). The knees were also a particular problem area for plumbers and electricians suggesting that this is an area of the body which needs to be seriously considered in multiple construction trades. These findings are consistent with previous research; in a study of 41 construction workers, Louhevaara (1999) found that twice as many ageing workers had poor kneeling postures compared to younger workers and Lemasters et al., (2006) reported that construction retirees experienced severe problems in their knees amongst other areas of their body. It is therefore important that construction workers of all ages are aware of the effects of working in their trades, not only for their working lives but also for when they choose to retire.

Despite these high reports of musculoskeletal symptoms, workers of all ages showed a high self-rated perception of work ability suggesting that musculoskeletal symptoms are perceived to be ‘part of the job’ and are not considered to debilitating to the point of being unable to work. The slight decline in work ability ratings with age could be found in the general population although previous research has found that work ability ratings decline at a steeper rate in heavy manual industries such as construction (Capanni et al., 2005). In addition to the relatively high ratings of work ability, workers of all ages demonstrated a deep level of understanding of their health at work and the risks to this when working in their trades when over 90% of workers made over 650 references to how they protect themselves at work. With the prevalence of musculoskeletal symptoms in the knees being so high, it is not surprising that over half of the workers spoke about using knee pads to protect themselves at work. A further level of understanding was demonstrated when workers discussed the design issues experienced with knee pads, such as them being too tight or not staying in place. Ideas were captured from the workers to resolve these problems such as them using materials around site or even creating their own bespoke knee pads from lagging foam and duct tape to ensure they could protect themselves whilst kneeling. This creativity and innovation is encouraging, as it shows workers thinking ahead in their trades as they expressed their desire to remain in work for as long as possible. In addition to workers making their own knee pads, some showed further insight into their health and wellbeing at work by creating their own benches before beginning their tasks. These bespoke benches, made at the specific comfortable height for each worker, may be reducing musculoskeletal symptoms in the upper back and shoulders by decreasing the need to be in bent over postures (Kee & Karwowski, 2001). Similarly, the use of bespoke knee pads may be reducing the risk of musculoskeletal symptoms in the knees by reducing pressure on the knee caps which has been shown to contribute to the development of prepatellar bursitis (housemaids' knee).

Those who actively go out of their way to create PPE or workbenches to make their work easier and safer are demonstrating their ability to improve their health and wellbeing at work in ways which require extra effort. Younger workers are also doing this, suggesting that it is not only the experience and knowledge of older construction workers that can be utilised, providing a sound basis for a participatory ergonomics interventions in construction involving end users. Previous research studies encouraging a participatory ergonomics approach have been successful, with multiple ideas coming from the workforce to improve health, safety and wellbeing at work (Vink et al., 1997; de Jong & Vink, 2000; Loch et al., 2010).

Several workers raised issues with their PPE and showed understanding in how they could have a negative impact on their health and wellbeing at work such as high visibility jackets being too hot, gloves not being of an adequate material and goggles steaming up. These problems have been raised in previous research demonstrating historical problems in the industry such as protective clothing restricting movement and goggles steaming up (Reid et al., 2001; Choudry & Fang, 2008; Lombardi et al., 2009). Workers again demonstrated a good level of understanding and insight by providing potential solutions to these problems such as better, more breathable materials for PPE, creating holes in goggles and having finger-less gloves to help with intricate tasks. These findings are similar to those found by Loch et al., (2010) who implemented 70 changes suggested by a pilot production line of workers using a participatory ergonomics approach, leading to an overall increase in productivity and a decrease in absenteeism in workers.

95% of workers had already made changes to the way in which they work to protect their health and wellbeing in their trades. In addition to discussions of the use of PPE, 35% of workers had also made conscious changes to their health outside of work to ensure they could work to the best of their ability in their trades. It was encouraging that workers of all ages had made changes, with workers aged 50 and over eating more healthily and taking supplements and younger workers playing recreational sports and regularly attending the gym. These changes demonstrated knowledge and awareness of workers of all ages of how their general health can have a strong effect on their performance at work. Younger workers also spoke of their intention to move away from the manual side of the industry, which also demonstrated a level of understanding regarding the damage they could do to their bodies if they spent a long period of time in their trades, which is consistent with previous findings (Tookey & Chan, 2001).

The high number of suggested changes from workers illustrated their ability to consider ways in which to maintain and improve their health and wellbeing at work. It was poignant that not all suggestions were high in cost meaning that change could potentially be effectively implemented in a short space of time. For example suggestions such as improvements to toolbox talks indicate that workers are keen to continue learning and see these as an effective way of doing so, which has also been found in previous research (Albers et al., 1997; Choudry & Fang, 2008). The high number of suggested changes also shows the confidence of the workers in putting their ideas forwards, a concept which has been questioned by previous research due to workers' fear of job loss in terms of reporting issues (Irvine et al,. 1994). However, there were several workers who initially claimed that change was not needed, potentially supporting the theory that workers fear job loss and as a result are less keen to share their ideas for change with the rest of the workforce.

Other suggestions such as higher levels of supervision of younger workers on site have been found in previous research, suggesting that these are historical issues on construction sites (Village & Ostry, 2010). Suggested improvements to facilities such as hot water and toilets are important to the wellbeing of workers and provide a basic feeling of value; Whysall et al., (2007) claimed that these psychological aspects of the environment are often overlooked by ergonomics consultants, once again reflected by older workers in this study referencing how important it is to them to keep warm in cold environments; being exposed to the cold at work has been shown to cause pain in the wrists, knees and abdomen (Inaba & Mirbod, 2010).

Workers demonstrated the consideration they have for the entirety of their jobs and not just their individual trades when discussing their working environment. These discussions support previous research findings that construction workers take pride in their work, their trades and their place of work (Watts, 2007; Leaviss et al., 2008a). However this contradicts findings from Tookey & Chan (2001) who stated that it is well known that construction sites suffer from poor ownership, referring to 'the phrase that pays' being "Who? Me? Clear up?" suggesting that for a transient, sub-contracted workforce, ownership and pride taken in the job may not be as strong. Concerns about the working environment such as a lack of natural lighting and ventilation demonstrates an awareness of the potential effects these poor conditions could have on their health and wellbeing at work. Carpenters and joiners have been found to be particularly at risk to dusty environments, with long term average exposure being more than 1.5 times the advised occupational exposure limits (Spee et al., 2007). In addition to this, inadequate lighting is considered to be an important cause of construction accidents (Moser et al., 1999).

Over a quarter of workers spoke about increasing their manual handling consideration, whether this be through using mechanical lifting aids or working as part of a team to protect themselves from injury. These specific changes were also recorded by Village & Ostry (2010) who found that 36% of workers got help from a co-worker when lifting and 11% were more aware of hazards and were more careful. Using devices for manual handling has been cited as one of the best ways to reduce physical work demands (van der Molen et al., 2004). The changes made by workers highlight their understanding of the risks to their health and show the efforts they are making to maintain a high level of work ability within their trades through the use of mechanical equipment in addition to taking more care when lifting.

Overall, construction workers of all ages and trades reported experiencing musculoskeletal symptoms within the previous 12 months and seven days. Many of these workers attributed their symptoms to their jobs, consistent with previous literature, demonstrating the essential need for both further research and action to be taken to ensure workers of all ages can continue to work healthily and safely within their trades. The high number and variety of suggestions and changes that have already been made and are being maintained by workers of all ages indicates they are highly aware of their health and wellbeing at work and have demonstrated that they are willing to make changes to ensure they remain fit and healthy. Despite the initial resistance from some workers, many were keen to share their ideas and it is important that they are given the opportunities to do so. This can encourage good practice and healthy working behaviours for workers of all ages, contributing to a healthy and productive workforce.

4.9 Limitations

Participants were selected using a purposive sampling strategy; although a relatively small sample care was taken to ensure the sample was as random and representative as possible by asking the managers of the sites to select appropriate participants for interview based on detailed exclusion criteria. However, a bias may have been introduced based on the motivation of site managers to select responsive individuals. Despite this, there were a variety of participants interviewed and there was no obvious bias present within the selection of participants.

Within this sample there may have also been the presence of a 'healthy worker effect'. The cohort of construction workers available for interview were likely to be relatively fit and healthy and feeling able to continue with their work. This may have potentially eliminated workers who were strongly affected by their work on a day to day basis which may contribute to a biased set of results. The healthy worker effect has been identified historically in research studies in heavy manual industries (Cook et al., 1996; Shephard, 1999; Dement et al., 2009). Despite this, a trend similar to previous research was seen within the prevalence of musculoskeletal disorders and age.

Data was collected across a period of eight months from May to December 2013 which may have caused potential bias in terms of the discussion around environmental issues such as hot, cold and wet weather. This may have also influenced discussion around the warmth of personal protective equipment, the restriction of thick clothing and the effect rain has on goggles. The weather has also been shown to have an effect on the number of musculoskeletal symptoms reported (Inaba & Mirbod, 2010).

Construction is well known for being a male-dominated industry and also for having a 'macho' culture (Feeney, 1986; Tookey & Chan, 2001; Rawlinson & Farrell, 2008). This was evidenced in many of the interviews, with particular reference to 'just getting on with the job' and one worker stating "if you didn't like it, you could always go and be a ballerina". As the researcher was a young female with limited knowledge of the day to day running of a construction site, this may have influenced results of the interviews.

During the interviews and in some of the companies, workers were on price work meaning that they were paid in terms of their productivity and how quickly the job was completed. This may have led to a potential bias in the interviews as workers may have given answers they thought the researcher wanted to hear rather than discussing their own ideas at length to keep interviews as short as possible. A few construction workers were considerably less co-operative than others, answering with short, non-descriptive answers. It was also difficult at times to get workers to consider the effects of their job on their body, when the tasks have become second nature and often sub-conscious. These issues were overcome with the use of additional prompts and probes in as timely a manner as possible for workers who were on price.

As data collection was conducted in the field in a naturalistic setting there was a considerable amount of noise during several of the interviews. This meant that it was sometimes difficult to conduct interviews with participants. This also had an effect on the privacy of the interviews, as the majority of the sites were peripatetic and therefore managers often surrendered their offices for the interviews to take place. In these situations, the researcher ensured sensitive questions regarding management and supervisors were asked when there were no additional persons in the offices and that the microphone of the Dictaphone was adequately placed to pick up the voice recording. Similarly observing workers on site was difficult; some sites required the researcher to be accompanied and on others, workers were un-cooperative, particularly if they were on price work and needed space to complete their tasks. Where possible, the researcher was accompanied on site and took care to remain out of the way during observations.

Workers were encouraged to talk about changes they had already made to their working behaviours and practices as well as physical changes to the design of their workplace. This lead to some issues as workers often had made changes without consciously realising; a phenomenon recognised in previous research studies. Garrigou et al., (1995) spoke about tacit knowledge, where knowledge may have been acquired in an implicit was with individuals not being aware that they have acquired it. The researcher used various prompts and probes where necessary to fully immerse the participants in their jobs and how they may have made changes to improve their jobs, make them easier or more comfortable. To overcome this limitation further, multiple data collection methods could have been used if there was more time available, such as contextual conversations and observations (Phelps & Horman, 2010).

4.10 Conclusions

The results supported the following conclusions:

- Construction workers of all ages experience aches and pains with a large number of these being directly attributed to their work. Despite this, they rate their work ability relatively highly and have a strong desire to remain working into older age.
- Construction workers of all ages have a good understanding of their health at work and the risks to this when working in their trades; this was demonstrated by the very high number of workers discussing their use of PPE within their trades such as gloves, knee pads and goggles.
- Construction workers of all ages have creative ideas and innovations to make their jobs easier, safer and quicker. Workers came up with over 250 potential ideas and had made over 400 changes to their jobs and in their workplace. Ideas ranged from low cost solutions such as more supervision of younger workers on site, better facilities and better knowledge transfer systems in toolbox talks to make them more memorable and relevant, to higher cost solutions such as changes to the design of PPE, more apprenticeships and better human resources to make workers feel more valued.
- Workers have demonstrated a good awareness of their jobs and also their desire to remain fit, healthy and knowledgeable in their workplace.

Many ideas were captured and these conclusions lead to the recommendations that stakeholders in the construction industry should make efforts to realise the qualities of their workers and ensure that the experience of older workers is not lost. A further recommendation is to facilitate good working practices and healthy working behaviours by engaging the workforce in improvements within the industry. Using a participatory approach to achieve this could lead to a more engaged, productive and healthy workforce.

5. Study two: focus groups with stakeholders

5.1 Introduction

An ageing population in the UK is also creating an ageing workforce:

> *"from the moment they are categorized as 'older workers', individuals become potential targets for prejudice and discrimination related to ageing"*
>
> (Desmette & Gaillard, 2008)

Previous literature has identified how both positive and negative perceptions of older workers can influence how they are treated in the workplace (Taylor & Walker, 1994; Loretto & White, 2006a). This can lead to (intentional or otherwise) unfair treatment of older workers; it is essential that workers of all ages are given the opportunity to look after their health and wellbeing in their workplaces and are able to work for as long as they wish. Construction is well known as a tough industry for workers to age healthily in, with heavy manual labour and harsh working environments being commonplace. The previous chapter (Chapter 4: study one) showed that construction workers of all ages have many good ideas and an understanding of their health and wellbeing at work together with a huge amount of innovation and creativity to improve their jobs (Eaves et al., 2016). Previous research has shown that ideas from the workforce coupled with buy-in and support from managers and supervisors can lead to the development of changes in the workplace which can facilitate healthy working behaviours, healthy ageing and longer working lives (Vink et al., 1997; Kramer et al., 2009; Loch et al., 2010). It is essential that supervisors, managers and employers are aware of the extensive knowledge and experience held within their workforces and that they utilise and encourage this to the best of their ability. Idea sharing and knowledge transfer between workers of all ages and trades can encourage and facilitate healthy working behaviours which in turn can facilitate healthy ageing in the construction industry.

5.2 Aims and objectives

The aim of this next stage of research is to explore senior stakeholders' perceptions of older workers and investigate barriers and opportunities to change within the industry to improve health and wellbeing and facilitate longer working lives.

The objectives of this chapter are:

1. To capture senior stakeholders' perceptions of older workers in construction.
2. To explore opportunities and barriers to change within the construction industry when presenting ideas from the workforce.
3. To understand how senior stakeholders in the industry would want to move forward with engaging their workforces to improve healthy ageing, health and wellbeing.

To achieve these objectives, an exploratory study was conducted using semi-structured, in-depth focus groups with senior stakeholders in construction organisations to explore opinions about older workers and change within the industry which could facilitate healthy ageing, healthy working behaviours and idea generation.

5.3 Sampling

A purposive sampling strategy was used to select appropriate stakeholders within three construction organisations. For continuity purposes, the main contacts of the three organisations involved in the previous research study (Chapter 4) were contacted (maintenance facility, domestic build company and civil engineering company). The main contacts were asked to purposefully select participants of any age, but who would be able to contribute to discussions on older workers and opportunities and barriers to change within their workforces and in the construction industry. It was important for appropriate stakeholders to be recruited as they would need knowledge and experience of the culture of the workforce in order to discuss opportunities and barriers to change. Care was taken to ensure the sample was as random as possible within the constraints of the sampling strategy; purposive sampling was considered the most appropriate strategy given the specific needs of the focus group. It has been cited as a technique which is "most effective when one needs to study a certain cultural domain with knowledgeable experts within" (Dolores & Tongco, 2007).

5.4 Study design and rationale

One focus group was held within each of the three organisations, with 5-8 participants per group. Sample size was defined considering the peripatetic nature of construction sites and the fact that managers and other stakeholders often move on after the completion of a project, in addition to consideration for the time it would take for focus groups to be conducted. The contact from each organisation was briefed on the study in order to select appropriate stakeholders to be involved in the focus groups. The contact for the maintenance facility was the manager, for the domestic build company, the Director and for the civil engineering company the Project Manager of one site was contacted. They were asked to recruit stakeholders such as health and safety and occupational health professionals to take part in the focus groups. Ethical approval was issued in June 2014 by the Ethical Advisory Committee at Loughborough University. Data was collected between July and August 2014. The researcher worked with the main contacts in each organisation to secure appropriate dates, times and locations for focus groups to be held. In two of the three cases, the researcher travelled to the work site to conduct the focus group. With one organisation, a hotel conference room was booked as several site managers from various locations around London were involved.

Participants were introduced to one another if they had not already met in advance and given a brief introduction to the purpose and aims of the focus group. In addition to this, participants were also given an information sheet explaining the purpose of the study and what was expected of them (Appendix A17). They were also informed of their right to withdraw at any time and were asked to give their consent to take part and to be audio recorded (Appendix A18).

5.5 Focus group schedule

Based on the review of the previous literature and methodologies (Chapters 2 and 3) and the findings from the previous research study (Chapter 4), a focus group schedule was developed and split into three main themes to facilitate discussion (Table 27). Under the theme of ‘views’, stakeholders’ perceptions of older workers were explored, to investigate the opportunities and barriers for change in the industry based on ideas suggested by the workforce the theme ‘design’ was used and to explore how stakeholders intended to continue engagement and involvement of their workforce if they wished to, the theme of ‘moving forward’ was used.

Table 27: Focus group schedule

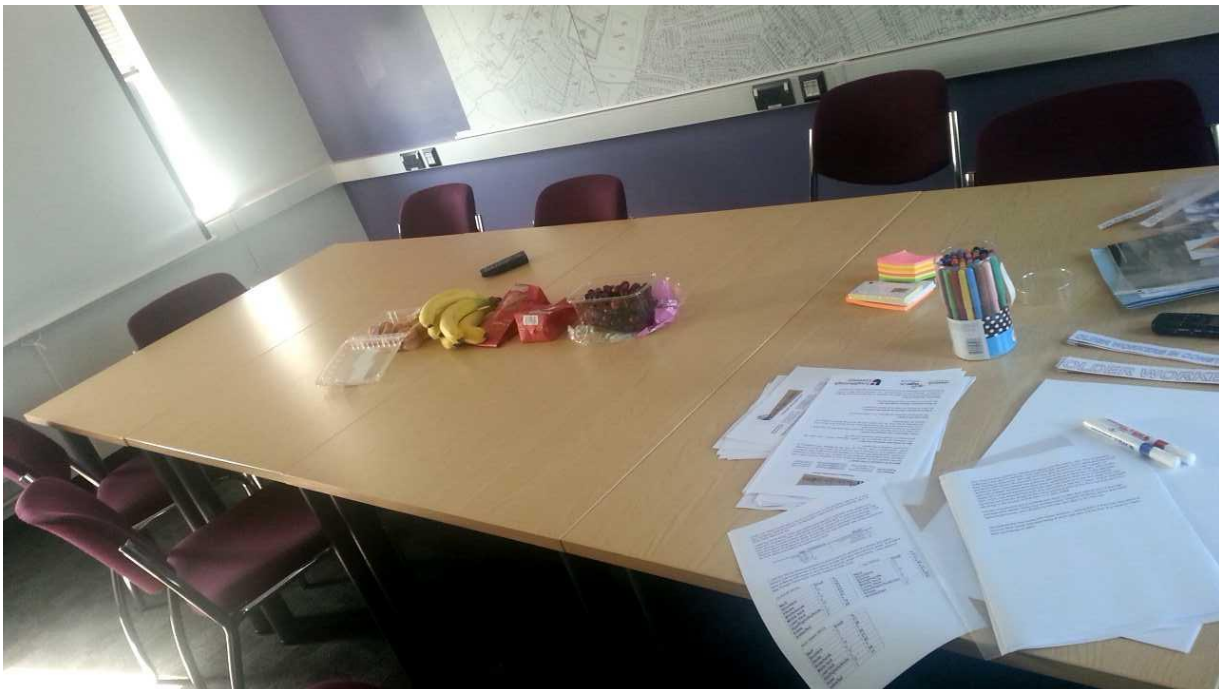
Theme	Sub theme	Prompts	Time (mins)	Equipment
Welcome and introduction		*- Context and background* *- Ageing population* *- Older workers* *- Keeping older workers in the industry*	5	Vocal Presentation
Views	Perceptions of older workers	*- No judgement, write anything you think of* *- Doesn't have to be your own perception* *- Use your experience and knowledge* *- What are the barriers of older workers?* *- What are the benefits to older workers?*	10 10	Large sheets of paper Pens Post-it notes
Design	Ideas from the workforce	*- Company specific findings* *- Workers of all ages have ideas* *- Other ideas*	5	Vocal Presentation
	Opportunities Barriers	*- Which of these ideas do you think would work?* *- Positives* *- Negatives* *- Barriers?*	20	Sheets with ideas on them Spare Sheets
	How can these ideas be implemented?	*- Cost* *- Prioritised list* *- Worker involvement* *- Time frames* *- Idea capture* *- Incentives*		Post – it notes
Moving forward	Continue engagement Encourage involvement	*- How will you keep your workers involved?* *- How will you continue to capture their ideas?* *- Competitions?* *- Tool box talks* *-Involving older workers in training* *The variety of options available*	10	Props *Leaflets* *Olympic Build 2014* *Constructing Better Health*

During the focus groups, stakeholders sat in a circular formation to allow for easy discussion between participants (Figures 19 and 20). To begin the focus groups, stakeholders were presented with a short context and background to the research, including statistics and information on the increasingly ageing population and workforce both globally and in the UK. A brief overview of older workers in construction was given, such as natural age related declines in physiological functioning which may be exacerbated by manual construction work, and also how research has shown that older workers are highly valued due to their skills, knowledge and experience. Participants were then asked to brainstorm and discuss their views on and perceptions of older workers; they were encouraged to be as honest as possible and were reminded that data would be anonymised. They were encouraged to write down both positive and negative perceptions and their personal experiences of older workers, (including in previous jobs) or perceptions heard from other colleagues or employees. These perceptions were then discussed with all stakeholders. The second theme for discussion was ‘design’; stakeholders were presented with a range of ideas and findings from the previous research study (Chapter 4) relating to their own workforce and wider findings from the whole sample (and the other two organisations). Stakeholders were then encouraged to discuss these within the context of their own company and in the wider context of the construction industry; the most important and relevant ideas to their company were discussed and also the opportunities and barriers for implementing these. The final theme of the focus group was ‘moving forward’; previous campaigns and resources related to health and wellbeing in the construction industry were discussed. For example, the ‘pound for porridge’ scheme on the Olympic Build construction site 2012, where workers were offered subsidised porridge to ensure they ate a sustainable breakfast or schemes available such as ‘Construction Better Health’ who operate medical screenings and health campaigns on construction sites. Stakeholders discussed these and were encouraged to brainstorm how they could move forward with the ideas suggested from their own workforces.

Where necessary and appropriate, the researcher used prompts and probes to encourage discussion within the focus groups. At each stage within each theme, participants were encouraged to write down their thoughts and opinions on post-it notes, to ensure all stakeholders were engaged and each participant had the opportunity to put their thoughts and opinions forward. In addition, the researcher made notes on a large flip-pad at the front of the room which facilitated further discussion around salient points. This in-depth, flexible focus group structure allowed in-depth qualitative data to be collected regarding stakeholders' perceptions and opinions of older workers and potential changes to their health and wellbeing in the industry.

Figure 19: Focus group set-up of stakeholders in the domestic build company

Figure 20: Focus group set-up of stakeholders in the maintenance facility



5.6 Data analysis

Focus group audio was recorded on a Dictaphone, the audio files were uploaded into NVivo10 software and were all transcribed verbatim by the researcher. The focus group transcripts were analysed individually by the researcher using quasi-statistical and template approaches (Miller & Crabtree, 1992). A quasi-statistical approach uses the frequency of references from participants to determine the importance of key themes within the interview. A template approach allows these key themes or 'nodes' (derived from an initial read of the data) to be used as a template for data analysis, which can be changed as the analysis progresses. Main themes were identified and then further sub-coded to make them more specific including 'repeatable regularities' which indicate the importance of the themes based on their repetition (Miles & Huberman, 1994; Rubin & Rubin, 1995). Relevant quotes were captured as part of the analysis to support and illustrate the findings.

5.7 Results

The results will be reported in line with the focus group schedule shown in Table 27. Qualitative findings will be reported under the theme of 'views' of construction stakeholders' perceptions of older workers. This will be followed by the results of the thematic analysis under the theme of 'design', detailing stakeholders' perceptions of the opportunities and barriers to the changes suggested by their workforces. The results section will conclude with the thematic analysis of the theme 'moving forward', where stakeholders' consideration of how engagement and involvement of the workforce can be encouraged to facilitate idea sharing and healthy working behaviours for healthy ageing.

5.7.1 Sample

A total of 20 construction stakeholders were asked to participate in a focus group (one in each of the three organisations) through the contact in each construction organisation. Two participants were unable to attend the focus groups at the last minute; one site manager from the domestic build company and one site manager from the civil engineering company, leaving a total sample of 18 stakeholders in a variety of roles (Figures 21, 22 and 23). For example, Figure 21 shows that the

Director of the domestic build company was approached with the brief for the focus group and the group composition. In all cases, the nominated contact from each of the organisations also participated in the focus groups.

Figure 21: Participants from the domestic build company (n=8)

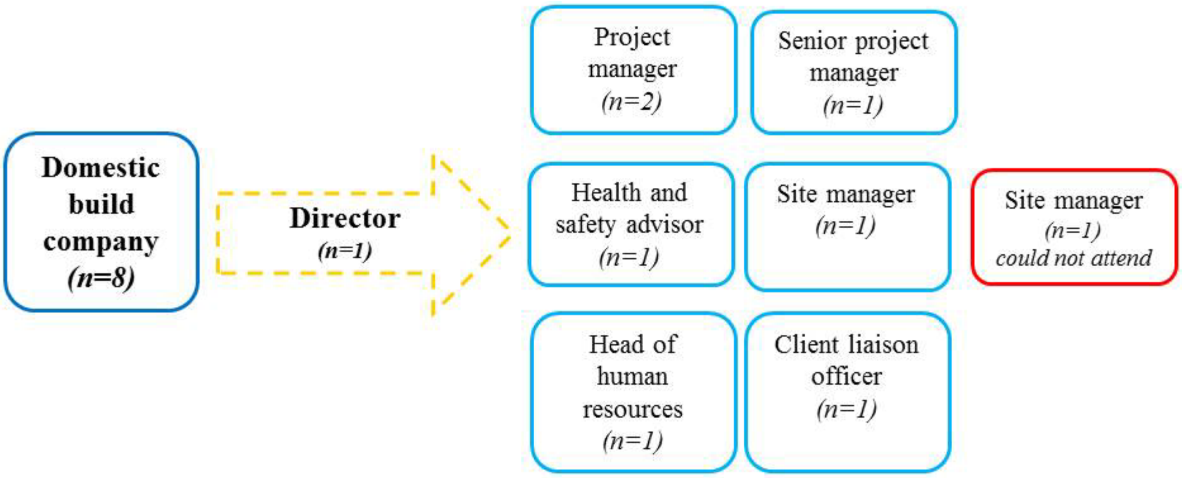


Figure 22: Participants from maintenance facility (n=5)

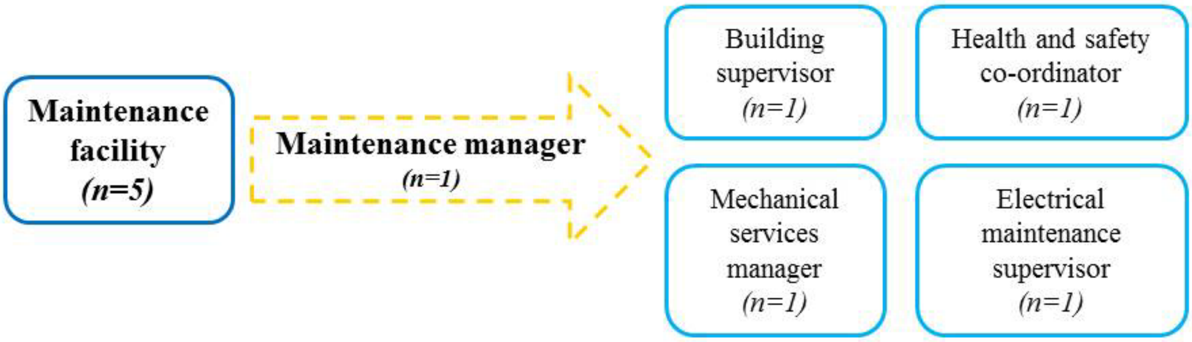
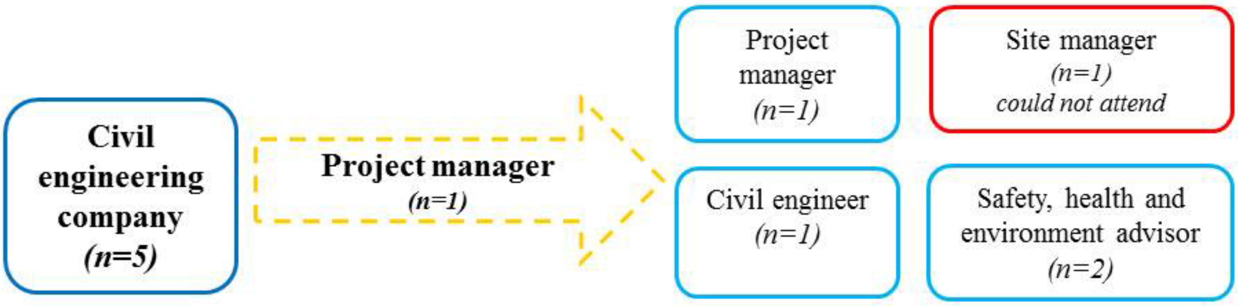


Figure 23: Participants from civil engineering company (n=5)



5.7.2 Demographics

Table 28 shows the organisation, occupation and age ranges of the construction stakeholders, the number of years spent in their current occupation and the number of years worked in the construction industry.

Table 28: Demographic data of construction stakeholders (n=18)

Organisation	Occupation	Age range	Years spent in occupation	Years spent in construction industry
Maintenance facility (*n*=*5*)	Maintenance manager	50+	25	25
	Building supervisor	35-49	20	30
	Health and safety co-ordinator	50+	7	30
	Mechanical services manager	50+	10	35
	Electrical maintenance supervisor	35-49	28	28
Domestic build company (*n*=*8*)	Director	35-49	6	25
	Head of human resources	50+	25	30
	Site manager	35-49	9	19
	Project manager	35-49	16	26
	Project manager	35-49	10	26
	Senior project manager	50+	19	40
	Health and safety advisor	25-34	3	5
	Client liaison manager	35-49	6	15
Civil engineering company (*n*=*5*)	Project manager	35-49	16	22
	Project manager	35-49	13	14
	Civil engineer	25-34	5½	6½
	Safety, health and environment advisor	25-34	3	3
	Safety, health and environment advisor	35-49	10	10

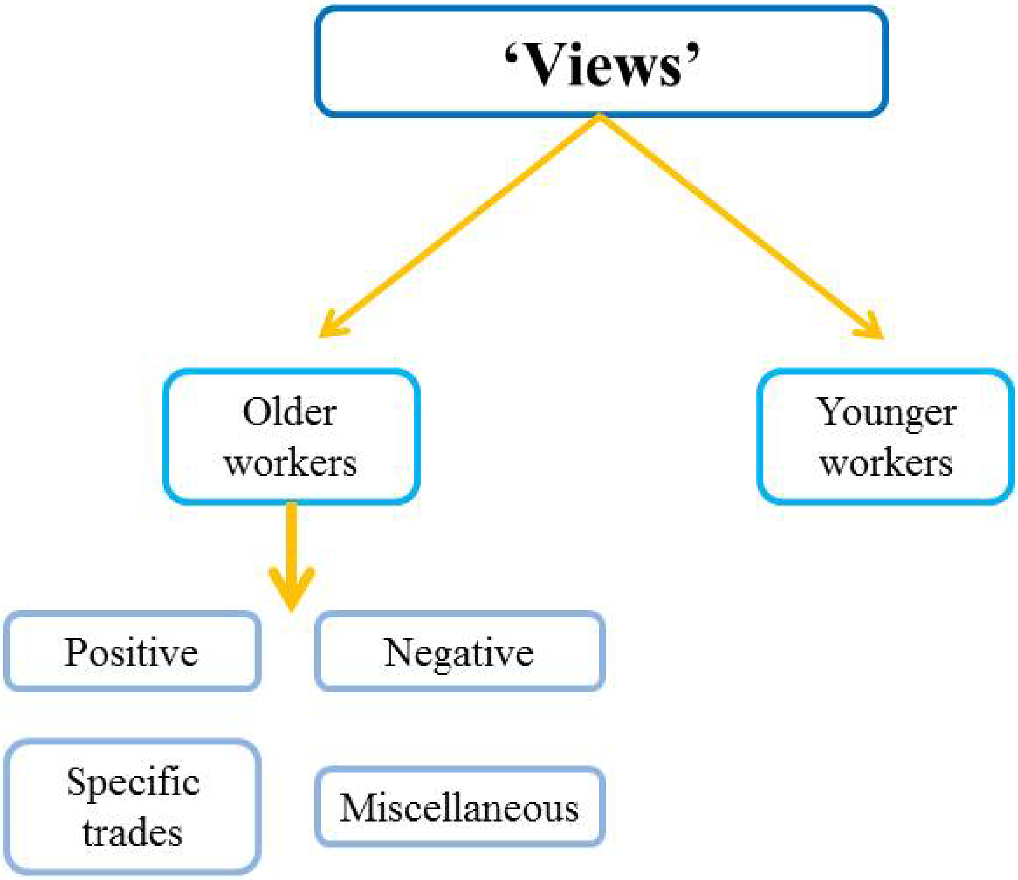
5.7.3 Thematic analysis

Stakeholders were encouraged to discuss any thoughts they had within the themes (Table 27) as freely as they wished, with prompts and probes being used where necessary, meaning that not all prompts from the schedule were used with every focus group. The results of these themes will be presented in terms of the thematic analysis carried out by the researcher.

5.7.3.1 Views

Figure 24 illustrates an example of thematic analysis under the theme 'views'. From an initial read through of the focus group transcripts, where participants were asked to brainstorm their perceptions of older workers, two main sub-themes emerged; 'older workers' and 'younger workers'. 4 main themes were apparent within the theme of 'older workers'; 'positive' perceptions, 'negative' perceptions, older workers within 'specific trades' and miscellaneous perceptions, which were not repeated frequently enough to form their own theme.

Figure 24: An example of thematic analysis of focus groups with construction stakeholders (n=18)



Older workers

In total, 89 references were made about older workers across the three focus groups; 43 were specific positive and negative references about older workers (48%), 40 were miscellaneous (with not enough repeated regularities to form themes) (45%) and 6 were related to older workers in specific trades (7%). An additional 34 references were made about younger workers. Table 29 shows a summary of positive and negative references made about older workers and Table 30 shows a summary of the miscellaneous references made about them; some of these references were repeated regularities and therefore only feature once in the table. Figure 25 shows an example of the brainstorming notes taken by stakeholders in the focus groups.

Table 29: Summary of positive and negative references to older workers (n=43)

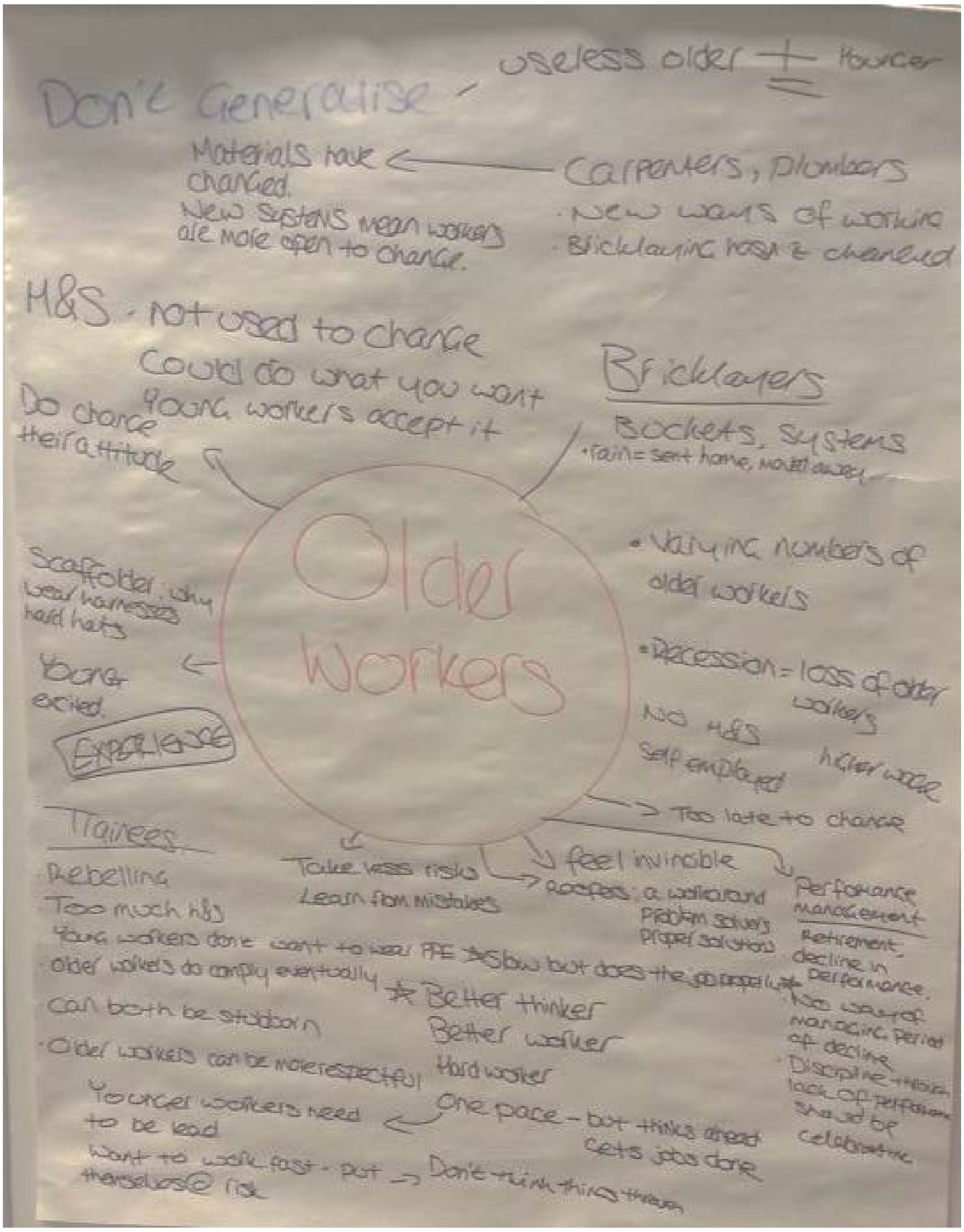
Positive references *(n=24)*	Negative references *(n=19)*
More knowledgeable **	Set in their ways **
Change their habits **	Not wanting change *
More respectful *	Work at a slower pace *
More loyal *	Poor habits *
Pass on knowledge to younger workers *	Don't comply with health and safety rules
Work at a slower, but better pace *	Feel they are invincible
More open to listening *	Difficult to manage performance
Know what's expected of them	Moan at younger workers a lot
More experienced	Think they know best
More skilled	Take more risks
Better job expertise	Less qualifications
Less lazy	Physically unable to do some of the work
Good problem solvers	Less ambitious and driven
Better thinkers	Can't keep up with technology
Good work ethic	

** repeated references*

Table 30: Summary of miscellaneous references about older workers (n=40)

No risk assessments for older workers	Lack of older workers on some sites
Previous life experiences	Accident rates are very diverse
Safety critical medicals 45 years +	Older workers enjoy a slower pace
knowledge transfer to younger workers	No concern about workers being "too old"
Shouldn't generalise with older workers	Individual variation
It's easier for them to work elsewhere	They know all about health and safety
They move to different jobs	Lot of older workers die before 60
Harsh environments are not pleasant	Unreliable trade / less employment
No workers coming up behind	Concern about them leaving the workforce
Trades workers have been lost in the recession	Migrant workers changing age demographics
Not going to make them climb crane towers	Large gap in the middle between 'young' and 'older' workers
Difference between 'older' and 'more experienced'	Need a mix of both young and older workers

Figure 25: Example of brainstorming sheet on perceptions of older workers from stakeholders in the civil engineering company



Positive perceptions of older workers

Stakeholders from the civil engineering company made 63% of the positive references about older workers (*n=15*) such as them being more respectful and more knowledgeable. 33% of positive perceptions (*n=8*) came from the domestic build company such as older workers wanting to remain in work and being happy to adopt new ways of working. Stakeholders from the maintenance facility made only one positive reference about older workers; they were considered to be very valuable due to their extensive knowledge and experience.

The most common positive reference about older workers was related to their experience and knowledge which was highly respected by stakeholders in all three organisations. Stakeholders in the civil engineering company recognised that the older workers may have better ideas about how to do their jobs based on their experience in their trades and stakeholders in the domestic build company identified how this level of experience in may contribute to less risk taking behaviours, often making them ‘better workers’;

> *“they’ve done everything we ask them to do before, they think of better ways of doing things”*
>
> (Civil engineering company focus group)

> *“I’ve got a scaffold supervisor, he’s 58 years old…he’s ten times all of his other scaffolders, he’s ten times the man of the other scaffolders he’s got working for him, he’s ten times the thinker”*
>
> (Domestic build company focus group)

Despite initial resistance from older workers, stakeholders felt that they were open to changing their habits, particularly relating to poor working habits and a resistance to wearing personal protective equipment (PPE). Stakeholders attributed this to the perception that older workers were more respectful and more likely to listen to supervisors and managers in comparison to younger workers. It was felt that this was as a result of older workers being more appreciative of having work due to their experience of the unreliability of employment in construction. This may also contribute to an increased sense of loyalty from older workers and was acknowledged by stakeholders in the domestic build company that older workers may be willing to change their behaviour based on this loyalty to their employers. It was also discussed that older workers may display some initial resistance to changes such as personal protective equipment (PPE) regulations, but quickly changed their behaviour out of respect and understanding for their supervisors.

“I had a chat with [a 50+ worker] the other day…he’s really grateful for working on this job, he loves it, always helps but yeh, he doesn't want to leave…the older guys are a bit more loyal, ‘cos there aren’t that many older guys that have left”

(Civil engineering company focus group)

The benefits of pairing younger workers with older workers were also noted for example helping younger workers ‘get to grips’ with site work quicker than if they were left to work alone. Stakeholders in the civil engineering company also identified that providing older workers with more responsibility could also make them feel more valued;

“they pass their knowledge onto the younger ones, they see it as a higher level of responsibility”

(Civil engineering company focus group)

Although it was acknowledged that older workers generally work at a slower pace, stakeholders admitted that it was steady and reliable in comparison to younger workers who would work at a faster pace but produce work of a lower quality;

“John will sit at one pace all week, but that one pace will get him twice the amount of work done because he’s also thinking three moves ahead”

(Domestic build company focus group)

Negative perceptions of older workers

21% of the references made about older workers were negative (*n=19*); the highest number being from the domestic build company (58%, *n=11*), followed by the civil engineering company (26%, *n=5*) and the maintenance facility (16%, *n=3*). Negative references were made mostly with a sympathetic and understanding tone from stakeholders; they were aware that older workers had experienced different regulations when beginning in their trades, contributing to a confusion and resistance towards PPE and working practices. They also acknowledged how age related declines in physical abilities may affect their ability to work at a quicker pace.

The most common negative reference made about older workers was that they were set in their ways and were against change in the workplace. They proposed that this was a result of them having ‘old school habits’ due to working in their trades for many years and having an air of ‘invincibility’ about them, which caused issues for supervisors. For example, the need to wear additional PPE on site due to relatively new regulations which were not in place when these workers first started working in their trades. Stakeholders also felt that many older workers think it’s too late for them to change, that there is no point in changing their behaviour ‘because it's never done them any harm before’.

> *“the older construction worker doesn't want to comply with health and safety rules, they’re not used to the change…you could do what you wanted really whereas now…they have to comply to regulations”*

(Domestic build company focus group)

In addition to PPE and regulation changes, it was also identified that the struggles experienced by older workers may relate to changes in qualification requirements on building sites. Construction workers are now required to sit exams in order to carry out particular tasks on site such as operating machinery. Stakeholders in the domestic build company were aware that these were not required when older workers began in their trades;

> *“they might be the most skilled people in the world but they won’t have the qualifications to actually go onto site, they have the skills but no blue card. They may be the best chippy in the world but because they can’t read or write, they can’t sit through a test”*

(Domestic build company focus group)

Although the majority of negative references were made with an understanding towards older workers, there were feelings of irritability within the domestic build company. They spoke about how older workers ‘think they know best’ causing problems when supervisors try to implement site regulations;

> *“I think we’ve all had the die hards on site at one point or another haven’t we? Where you don't know anything compared to them”*

(Domestic build company focus group)

Stakeholders acknowledged the slower pace of older workers however this was counteracted by younger workers often compensating; older workers were often given slower, less physically manual jobs whilst younger workers took on the more physical tasks;

> *"you'll get the older boy now who will sit in the machine doing that whereas the youngens will be out in the hole laying pipes"*

(Domestic build company focus group)

The head of human resources in the domestic build company also identified a specific problem in the construction industry; performance management was considered to be a real challenge as it was difficult to 'manage their way out of the business' by setting a definitive retirement age, particularly in light of the recent abolishment of an 'official' retirement age for workers in the UK;

> *"now you've got a situation where everybody's going until they're 70 or beyond…I've got no way of managing that because you don't know when they're going to go…they could start winding down when they're 55 and stay until they're 70 so you've got a 15 year period where their performance is declining"*

(Head of human resources, domestic build company focus group)

Older construction workers also presented a difficulty for the head of human resources in terms of disciplinary action on site; he claimed that a consistent decline in the quality of work produced by an individual would usually result in disciplinary action however human resources personnel did not feel comfortable doing this with older, often very loyal, workers;

> *"you could be disciplining through lack of performance at a time where you should be celebrating their service with you and traditionally you give them a gold watch and a golden handshake but you're still disciplining them for poor performance which is a real dilemma"*

(Head of human resources, domestic build company focus group)

Stakeholders briefly mentioned the negative perceptions of older workers not being able to pick up new systems and new technologies on sites and also losing their ambition and drive to work hard.

Younger workers

When stakeholders were asked to discuss their perceptions of older workers, numerous comparisons were made with younger workers (32%, *n=34*). Stakeholders in the domestic build company made by far the most references (76%, *n=26*) followed by stakeholders in the maintenance facility and civil engineering company focus groups (12% each, *n=4*).

Stakeholders acknowledged that younger workers had less knowledge and experience and would benefit from shadowing their older counterparts. However in both the maintenance facility and domestic build company, problems with younger workers' rude attitudes were discussed and that some 'don't want to listen at all'. Despite these views, it was also identified that some younger workers were prepared to listen and learn from older workers; stakeholders in both the domestic build company and the maintenance facility spoke of how they felt this attitude came from growing up in a different generation;

> *"it's the generation they've been brought up in…it was given to them and given to them and they still expect it when they come to work"*

(Domestic build company focus group)

In contrast to these views, stakeholders in the civil engineering company said that younger workers were more likely to wear their PPE compared to older workers. However stakeholders in the domestic build company focus group did not agree, claiming that they believed younger workers thought themselves to be 'above the health and safety stuff'. Stakeholders in this company said that younger workers have more accidents on their sites, which they attributed to them being more distracted;

> *"they was probably twittering on their mobiles or something"*

and

> *"you look at the youngsters and they're either on their phone or they've got their finger up their nose and they're just not even taking on board what you're saying"*

(Domestic build company focus group)

Stakeholders in the civil engineering company also claimed that during a recent health and safety training event held at their site, younger workers were much more vocal and engaged in comparison to older workers, who appeared to 'just want to get it over with'. However, stakeholders in the domestic build company focus group put forward the view that younger trainees are difficult to engage with and seem to behave rebelliously;

> *"they're destructive kids anyway, they're coming onto a labouring, bricklaying, scaffolding"*

(Domestic build company focus group)

In addition to this, stakeholders in the domestic build company focus group acknowledged the faster (and beneficial) pace of younger construction workers, but counteracted this with the belief that the young workers were not aware of the potential negative effects of this on their body.

> *"the older workers…will think more of, 'if I do it in this method it will be easier to do' whereas the youngster will say 'nah it's quicker to do it this way'"*

and

> *"the youngsters just charge, it's like 'let's go, let's get it done' but then by doing that, A) they put themselves at risk of getting themselves hurt or other people and secondly, it takes twice as long because they're not thinking about it methodically"*

(Domestic build company focus group)

Specific trades

During discussions about older workers, stakeholders in the domestic build company referred to difficulties with specific trades. Older scaffolders and bricklayers were particularly cited as difficult to work with due to the lack of advances made within these trades in comparison to others such as carpenters, plumbers and electricians;

> *"scaffolders have worked in the industry for years and years and they're saying 'why should we wear a harness, why should we wear a hard hat…this is how I've done it for years'"*

and

> *"bricklaying hasn't changed since the year dot, same as scaffolding"*

(Domestic build company focus group)

Miscellaneous

Stakeholders in the civil engineering company spoke about how they rarely considered a worker to be "too old" to be doing certain tasks although did not specify 'why'. Interestingly, they spoke about having risk assessments for younger workers, perhaps because they are 'newer' on to site, with less experience but not for older workers. However when workers reached the age of 45 they were reported to be given more regular safety critical medicals. In addition to this, stakeholders in the domestic build company discussed the risks faced by older workers. An example was given where in a recent survey of their workforce they found that the average age of their crane rescuer was 51; the Director of this company admitted he did not feel comfortable sending a worker over the age of 50 to climb a tower crane, suggesting that perhaps more risk assessments need to be put in place.

Stakeholders in the civil engineering company were concerned that older workers were leaving their trades and that there was a lack of younger workers on site to 'take over', meaning there was a loss of knowledge in the industry;

> *"I think generally there's a trend where I don't think the knowledge base is being replaced. I think generally, the older workforce…quite willing to bring younger guys up to speed but whether they're necessarily available or interested in that is different"*

(Civil engineering company focus group)

This was also a fear voiced by stakeholders in the maintenance facility of an increasing number of young people choosing to go to University over working in a trade. Stakeholders in the domestic build company discussed how younger workers who start out in construction often leave trade work on site in favour of setting up and becoming managers (rather than trades workers) of their own sub-contracting businesses in order to save themselves from the heavy manual work, which in turn creates a loss of experienced older workers. Stakeholders also acknowledged a loss of older workers due to the unstable nature of the job;

> *"what killed it for the bricklayers was obviously the rest days or rainy days…they was going to work for a week and probably picking up two days money, so they move away from the industry all together"*

(Domestic build company focus group)

> *"one minute you're earning good money and the next minute you're on the dole"*

(Maintenance facility focus group)

This lack of job security was also identified as a potential cause of considerable stress, which could lead older workers to encourage their children to take different career paths;

> *"it's quite stressful to be fair…the continuity of it and then you pass that on to your kids and you wouldn't want them to work in the same industry"*

(Maintenance facility focus group)

Despite the range of negative perceptions, stakeholders in the domestic build company acknowledged that their workforces are made up of different individuals, which creates different working cultures on every site;

> *"you've got useless youngsters just as you've got useless older people and you've got talented youngsters and talented old people"*
>
> (Domestic build company focus group)

5.7.3.2 Design

As part of the focus groups, stakeholders were presented with the suggestions and ideas from the workers themselves to improve the design of their jobs and workplaces to encourage longer, healthier working lives and improve health and wellbeing (Chapter 4). These included improvements to facilities, the use of homemade/personalised PPE, the need for apprentices, improvements to human resources, design ideas for PPE and suggestions for changes to toolbox talks. Stakeholders were then encouraged to discuss these ideas and to consider the opportunities and barriers to making these changes in their organisations; images were used as prompts, to remind them of the range suggested by own their workforce (Figure 26).

Figure 26: Example of brainstorming sheet from workers in the maintenance facility considering opportunities and barriers to change

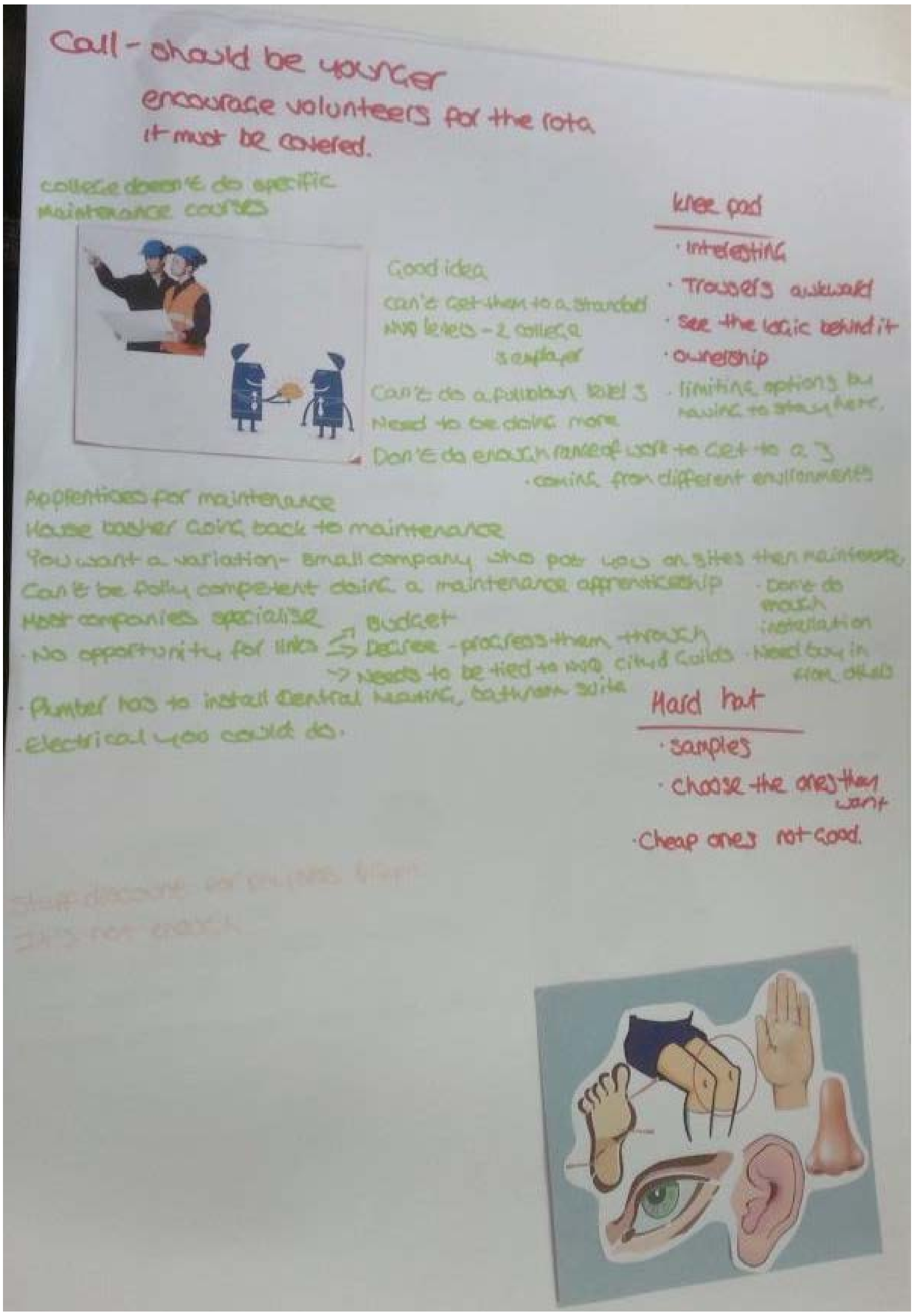


Figure 27 illustrates an example of the thematic analysis for the theme ‘design’; from an initial read through of the focus group transcripts, a number of sub-themes were developed based on the popularity with which they were discussed and the number of repeated regularities within the focus groups such as Personal Protective Equipment (PPE), facilities, toolbox talks and tools and machinery.

Figure 27: Example of thematic analysis of focus group transcripts

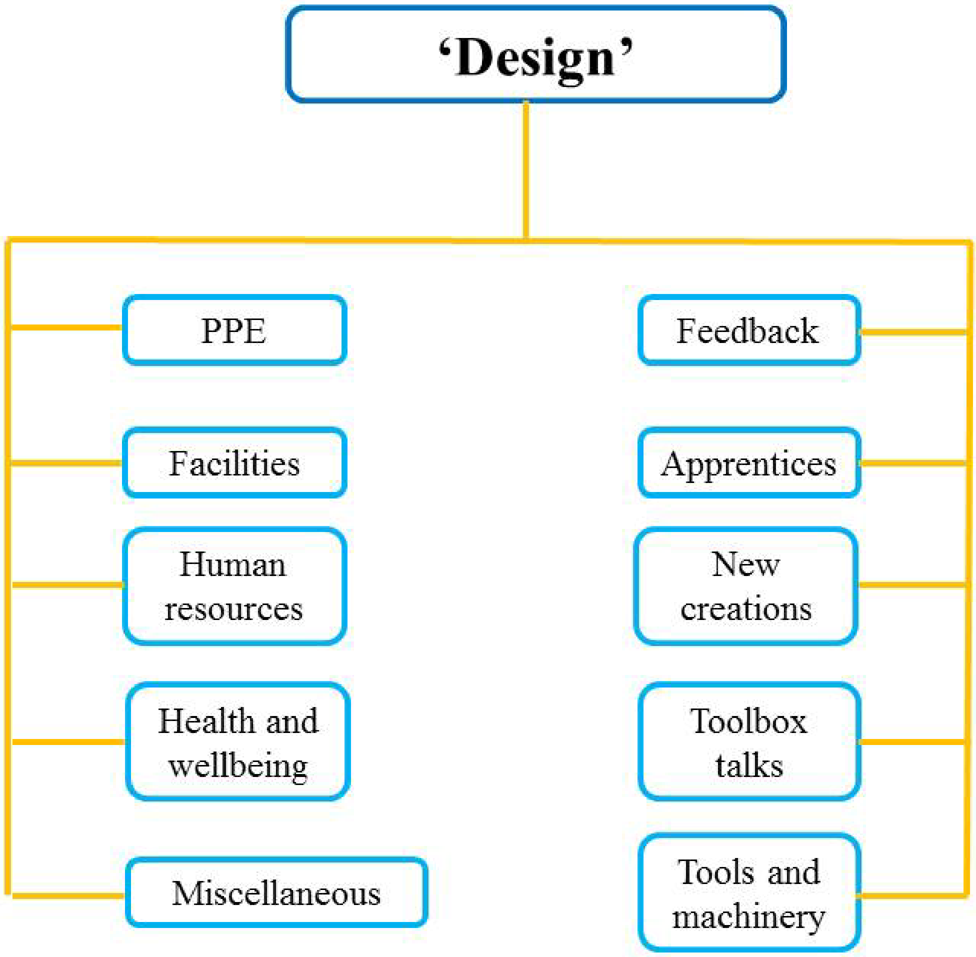


Table 31 shows the suggested ideas from the workers to improve the design of their jobs and workplaces that were discussed by the stakeholders. A total of 129 references were made under this theme, the most popular sub-themes were PPE (34%), facilities (20%) and apprentices (15%).

Table 31: Changes suggested by trades' workers that were discussed by stakeholders

Suggestion from workers	Participants making references (%)	Number of references
PPE	34	44
Facilities	20	26
Apprentices	15	19
Health and wellbeing	7	9
Miscellaneous	7	9
Human resources	5	7
New creations	5	6
Toolbox talks	5	6
Tools and machinery	2	3

PPE

The most frequently discussed suggestion by all stakeholders was PPE (34%, *n=44*). Stakeholders in the domestic build company made 55% of these references (*n=24*), followed by the civil engineering company (25%, *n=11*) and the maintenance facility (20%, *n=9*). There were a variety of suggestions from the workers that were discussed by the stakeholders including when to wear goggles, design of dust masks, quality of PPE, budget for PPE and knee pads.

Goggles

Stakeholders in the civil engineering company were not surprised to hear of the number of suggestions related to goggles coming from their workforce;

> *"welcome to our world, this is nothing new!"*
>
> (Civil engineering company focus group)

Workers within this company had suggested that changes needed to be made to the regulations, such as permission to remove goggles in wet weather as they steam up and considerably compromise vision. Stakeholders within this company acknowledged this request but felt that if they left the choice up to the workers this would cause chaos;

> *"I think part of the problem with the glasses is, you'd like to leave it to people's common sense, but if you do that we end up in boiling hot sunshine…and it rained at 8'o'clock this morning and then five hours later people are like 'oh it rained this morning so I haven't got to have my glasses on'!"*
>
> (Civil engineering company focus group)

Goggles were also a problem in the domestic build company; stakeholders in this focus group discussed how they had approached this issue by having an occupational health session where around 40 directly employed labourers sampled various PPE. Stakeholders claimed that the session had significantly improved communication about PPE but that this had slipped over recent years as over 30 (out of the 40) workers had left. This approach was also used by stakeholders in the maintenance facility; the manager collected six samples of different hard hats and asked the workers to choose which one was the best, and the chosen hat was purchased by the company for the whole workforce. Opportunities for change were identified such as involving workers in choices about PPE; however a potential barrier was sustainability of change due to the peripatetic nature of the workforce;

> “*we then set a standard which most probably slipped over recent years because we’ve only got about 6 guys left [out of 40 directly employed labourers]*”
>
> (Domestic build company focus group)

Design of dust masks

Another suggestion from workers themselves in the civil engineering company to stop goggles steaming up was to wear more PPE such as a ‘full face’ dust mask. Stakeholders in the focus group from this organisation found this hard to believe;

> “*that’s what they wanted?! What?! We have enough trouble getting them to wear what they’ve got!*”
>
> (Civil engineering company focus group)

In contrast to this, stakeholders in the domestic build company agreed that the full face mask was a good idea. A contractor of theirs, who was using new regulations and now insists on workers using a full face visor; this has eliminated the need for workers to be clean shaven (a prerequisite for wearing dust masks which need to fully fit the workers’ face). This PPE was seen as a benefit to the workforce as it could be used by all construction workers regardless of the amount of facial hair. Previously workers were sent home if they were not clean shaven, meaning that they lost a days’ pay and the company lost a days’ work.

Quality of PPE

Workers across all three organisations raised problems relating to the quality of PPE; the workforce of the domestic build company had concerns about uncomfortable boots, which did not last very long because they were cheap. The stakeholders in the focus group agreed with this;

> “*the site managers, well he doesn't wear them* [the boots] *because they’re uncomfortable so he goes away at the weekend and he buys a decent pair of boots…and puts it on expenses!*”
>
> (Domestic build company focus group)

All stakeholders acknowledged the fact that by buying cheaper PPE, it may not last very long and therefore they are accumulating higher costs in the long run by having to replace PPE sooner. Stakeholders identified an opportunity for a change; in addition to recruiting workers to 'test out' a variety of PPE before purchasing, they also suggested that workers could contribute their own money to the PPE budget to buy better quality equipment;

> *"say the health and safety department or the buyers, you've got a budget that you can spend on PPE per site for the company over the year…they should be saying…there's a thirty budget for your boots, if you want to put the additional cost then we'll deduct that out of your salary…you should be given that option…that could be something that's actually tied in with the terms and conditions of your employment"*

(Domestic build company focus group)

Budget for PPE

Another opportunity suggested by stakeholders in the domestic build company involved encouraging the workforce to consider how much money they spend on kit and accessories for their hobbies, in comparison to how much they spend on their PPE for work, to encourage them to consider their bodies at work;

> *"it might be worth asking people what they do as their hobbies…I bet they buy the best quality football boots, shin pads, cycle helmet but they can afford it for something that they use two or three hours a week"*

(Domestic build company focus group)

Stakeholders in the domestic build company also identified some significant barriers to change. They felt it would be difficult for workers to take ownership of their PPE as regulations from the Health and Safety Executive state that employers must provide workers with adequate PPE. They felt that this has a detrimental effect on workers' perceptions of ownership. They also believed that it would be difficult to convince both contractors and workers to spend more money on better quality PPE;

> *"it's drummed into everyone nowadays that it's down to the employer to buy your boots, to give you your gloves, but the employer will go 'yeh well they cost twenty quid whereas they cost fifty quid, you can have the twenty quid boots'"*

(Domestic build company focus group)

Another barrier to workers' suggestion to improve PPE was that cheaper suppliers of PPE did not always stock a wide range of sizes. For example, workers with larger hands had no choice but to use gloves which were too small, leading them to cut the finger tops from the gloves, presenting health and safety risks. There were lengthy discussions about the complexity of introducing new regulations for sub-contractors regarding the standard of PPE that must be provided to employees to ensure all workers wore the same;

> *"he* [sub-contractor] *showed me once the boot of his car and he had six different colours of safety helmets, about 10 different pairs of gloves and five different pairs of safety goggles and he had to remember which one went with what…site"*

(Domestic build company focus group)

Stakeholders discussed how the various suggestions for changes to PPE would be difficult to implement but that the benefits to both the workforce and the company would be tremendous; the workforce would have better quality PPE, the company would spend less money and the standards of PPE would be the same for all workers regardless of their employer.

Knee pads

Workers in the maintenance facility raised an issue which was specific to their workplace; they were required to carry out tasks in 'the voids'. These were tunnel-like runs, suspended in the ceilings requiring them to crawl through in order to carry out maintenance work. Several workers had suggested the use of rubber matting within these voids to protect their knees, however, when stakeholders were presented with this suggestion, the change was not seen as necessary due to all workers being provided with knee pads, free of charge. Workers had acknowledged this but felt that they were 'uncomfortable' considering they were providing for 'kneeling' rather than crawling. An alternative opportunity suggested by one stakeholder after this discussion was to remove the voids all together; however this change would take time, perhaps over the next five or ten years.

> *"alternatively, just wear knee pads"*
>
> and
>
> *"they are supplied with knee pads, all of them, they are supplied them for that reason"*
>
> (Maintenance facility focus group)

Within the maintenance facility, one worker had made his own knee pad out of lagging foam and duct tape; this caused some confusion with the stakeholders, as they did not understand why their workers were making up their own knee pads when they were provided with adequate knee pads from the company. There was however, a level of understanding from the point of view of personalisation and ownership. Stakeholders attributed these 'creations' as a lack of people management, suggesting that workers do not have the opportunity to discuss any problems they may be having with the PPE provided to them;

> *"it's self-managing really. It's a bit disappointing that the management of the site aren't doing it themselves"*
>
> (Maintenance facility focus group)

This presented an opportunity for better communication lines to be created between workforce and management, so that supervisors and managers could take more time to understand the specific needs of their workforce.

Facilities

Workers had also made suggestions for improvements to facilities on site such as hot water, toilet rolls and provisions of cold drinking water in hot weather. Facilities were the second most frequently discussed suggestion by stakeholders (19%, $n=26$) in the civil engineering and domestic build companies. This was not a topic of discussion within the maintenance facility focus group as the workforce had no suggestions for improvements.

Hot water

The workforce of the civil engineering company had raised their concerns about the lack of hot water on their sites; this was an issue that the stakeholders agreed needed to be attended to. There appeared to be confusion between the stakeholders in this focus group about these facilities; one stakeholder claimed the problem had been fixed and a boiler had been replaced, whereas another stakeholder spoke about water pressure problems causing boilers to 'blow up' in the past. There was also confusion regarding the extent of the problem; one stakeholder asked if the workforce had raised their concerns about hot water and showering or 'just purely hand washing', suggesting that this had not been previously mentioned by workers. As found in the maintenance facility focus group, these discussions uncovered a communication barrier between the workforce and management and also between managers and supervisors on this site. This presented an opportunity for better communication to be facilitated between management and the workforce to regularly assess the needs of their employees and ensure that changes were recorded in order to provide feedback to their workers.

Toilet rolls

Another issue raised by the workforce was the lack of toilet rolls available in their changing rooms; workers believed that this was a small element but significantly contributed to their overall sense of health and wellbeing at work. Whilst stakeholders acknowledged this suggestion, they identified a barrier to improving this situation by claiming that 'they disappear faster than they can be replaced'. An opportunity to overcome this was to use the 'big wall dispensers' that could be re-filled using a key, to stop workers potentially 'stealing entire rolls'. Other opportunities suggested by the stakeholders to improve the overall maintenance of the facilities on their sites was to implement a 'checking system' similar to those seen in facilities such as service stations and restaurants and also to replace the toilets with 'anti-vandal stainless steel' toilets or timber toilet seats to reduce damage;

> *"all of them have got the little tick list for people going in there and making sure it's been inspected"*
>
> (Civil engineering company focus group)

> *"I don't think we do enough…we don't put anti-vandal stainless steel bogs in, we don't put the multiple four roll dispensers on the wall in the corners so there's always lots there. We don't help ourselves do we?"*

(Civil engineering company focus group)

Provisions of cold drinking water in hot weather

Other suggestions from workers to improve facilities on sites with the domestic build company included provisions of cold drinking water during hot weather. Although this suggestion did not come as a surprise to the stakeholders, the Director of the company did not think that this was a necessary change;

> *"we've got a lot of staff coming from bigger companies and they used to supply those water coolers on site and again, I refuse it. If you get a construction worker who can't take sufficient fluids with you to work then there's something seriously wrong"*

(Domestic build company focus group)

However, site managers within this focus group did agree that more money needed to be put aside within the company budget for better facilities and that more consideration needed to be given to the appearance of their sites. It was acknowledged that it is the workforce who are doing the manual labour and therefore helping to bring in the money for the company, so they should be rewarded with adequate welfare facilities on site;

> *"need better welfare facilities, changing rooms, toilets, materials and equipment"*

and

> *"if the welfare facilities were better the workers might feel like they need to work harder"*

(Domestic build company focus group)

Opportunities for change identified by stakeholders included the introduction of welfare facilities such as pool tables and dart boards, which in turn would earn them points on the 'Considerate Construction Scheme', a voluntary scheme which aims to improve the image of construction by abiding by a code of considerate practice on sites. However, these suggestions were immediately met with potential barriers, such as workers not having time to use them as they only have a thirty minute lunch break and the lack of space on site deeming them a waste of money.

A potential barrier to improving facilities on sites brought up by stakeholders in the domestic build and civil engineering company was the perceived lack of use of such facilities and when they are used, the lack of care and respect shown by the workforce. Stakeholders had the negative view that there was a 'culture' related to building sites, where engaging workers to take ownership of the facilities on site was a difficult task;

> "*they bought a brand new toilet block with a shower in it and everything, immaculate…everyone was told the shower facilities were there…in those six years that shower cubicle was used twice*"

(Domestic build company focus group)

> "*there is that group of people who look after stuff and that you'd be more than happy to provide stuff for but as well there is a group of people who don't look after stuff and yes, they do mess it up for the other half*"

(Civil engineering company focus group)

Apprentices

Due to the older workforce in the maintenance facility, an important suggestion from these workers was to increase the number of apprentices on site so that they could pass down their knowledge and experience (15%, *n=19*). Stakeholders acknowledged the benefits of having apprentices on-board, but the maintenance manager explained the logistical difficulties apprentices would face when trying to complete their qualifications whilst working at their organisation. Apprentices are required to complete a range of tasks in order to gain the full qualification, and the maintenance facility did not offer a wide enough range for completion of all the apprenticeship levels;

> *"apprentices in my opinion, good idea, here we can't…a lot of them haven't done the full apprenticeships…we could push them to a* [level] *two here but you won't get a full blown apprenticeship level grade three here…we can't do enough of it…we don't do enough of the range of the works to get it to a three to satisfy the competency levels"*

(Maintenance facility focus group)

Stakeholders went on to discuss the difficulties in finding younger workers with the adequate experience or qualifications in maintenance work. This was an important barrier for the stakeholders of this organisation, as employing workers from the construction industry meant that generally they did not have the necessary skill level;

> *"90% now you're gonna end up getting someone who's worked in the construction industry on sites who's just come from house bashing"*

(Maintenance facility focus group)

There was interesting and extensive discussion between all stakeholders in this focus group about why apprentices could not be taken on especially as the maintenance facility was attached to a University. One stakeholder in particular did not understand why they could not employ an apprentice who could also complete a degree at the University, although the maintenance manager then clarified that this would be considered as 'training someone up' rather than an official apprenticeship;

> *"the surprise for me when I came here is that there's not actually the opportunity to link…linking that apprenticeship through to a degree, actually why in a University like this, why can't we take someone on at 18 years old with good A levels and prospects and actually build the apprenticeship around that?"*

and

> *"that's not an apprenticeship you're talking about now, that's just about training somebody to what you want, apprenticeships are a standard agreed level of workmanship from a City and Guilds which is issued between an NVQ"*

(Maintenance facility focus group)

The extensive discussion on this topic was indicative of a lack of communication between the stakeholders in the maintenance facility and also between the supervisors and the workers. Although significant barriers meant that apprenticeships would be unlikely, a need for better lines of communication was identified to facilitate discussion and feedback between the workers and managers within this organisation.

Health and wellbeing

Various suggestions from the workforce were related to health and wellbeing such as provisions of sun cream and healthy breakfasts on site, having occupational nurses on site and also access to physiotherapy to ease work-related aches and pains. These were discussed by stakeholders in the domestic build company and the maintenance facility (7%, *n=9*). These were not discussed by stakeholders in the civil engineering company as their workforce did not suggest any of these ideas.

Workers in the domestic build company had spoken about the provision of sun cream; however the stakeholders perceived this to be a personal responsibility of the workers;

> *"I've always flatly refused to supply suntan cream to site workers, so if you're a construction worker and you're ginger for example you should be taking your own sun cream because you're working outside"*
>
> (Domestic build company focus group)

All stakeholders in the domestic build and maintenance facility focus groups acknowledged that occupational health is likely to gather momentum in the near future and identified opportunities for change that are already happening on many construction sites such as occupational health nurses on site and companies offering free porridge and fruit for breakfast. The benefits of providing workers with a free breakfast were also discussed by stakeholders in the maintenance facility, however this idea was considered to be 'off the wall' and the idea of having occupational nurses was considered to be too expensive. In the interviews with workers in the maintenance facility, they had suggested discounted or free gym memberships (previously available but discontinued due to budget cuts) and discounted access to physiotherapy. Although these were acknowledged as 'cracking ideas' by the stakeholders in this organisation they claimed that staff were already given a discount but that perhaps it was ‘not enough’. During discussions about ‘health benefits’ for workers, one stakeholder from the domestic build company spoke about the successful campaign on the London 2012 Olympic building site which provided workers with free breakfasts if they started work before a certain time. However a stakeholder from the maintenance facility considered a possible barrier to these changes within the facility;

> *“I know where you’re coming from…but if somebody turned around to you and said ‘right I want free porridge for all the lads’ what’s going to happen? Consider that as off the wall and I’d dismiss it!”*

(Maintenance facility focus group)

Human Resources

Human resources were also discussed by stakeholders in the maintenance facility (5%, *n=7*). Workers had suggested that older workers should be removed from the ‘on-call’ rota, which required them to come into work at any time during the night in the event of an emergency. The stakeholders in the focus group agreed with this and identified an opportunity for change, whereby older workers were given the option to remove themselves from the rota or to ask younger workers to cover their shifts;

> *“there isn’t* [consideration given to older workers] *but there should be, that’s my opinion…I think it is 62 that you can actually withdraw from working any shifts whereas we expect people to be on call ‘till 65, being woken up at 2’o’clock in the morning at 65, 64, to come out into a cold, freezing environment is not the right way, that’s not good for your health”*

(Maintenance facility focus group)

Toolbox talks

A range of suggestions were made from the workforces in the domestic build and civil engineering companies to make toolbox talks more interesting and relevant (5%, *n=6*). Stakeholders in both of these companies were receptive to these suggestions, with the Director of the domestic build company identifying an opportunity to make toolbox talks ‘more interactive by using flash cards’ and the stakeholders in the civil engineering company had the idea of including more ‘gory videos’ to have more impact and using modified pairs of glasses to replicate eye injuries. Both companies were keen to encourage more engagement and interaction;

> *“I despise toolbox talks in their current form and we’ve already mentioned about doing more visual, touchy feely stuff…we’ve got some flash cards coming out which are pretty graphic and we've introduced a simple test on the back of the cards so we say, tuck your thumbs inside your palms try and do your shoelaces up”*

(Domestic build company focus group)

New creations

Stakeholders in the domestic build company were presented with and discussed the novel creation of workers who made up their own work bench to enable a steady working surface at a height suitable for individuals. Stakeholders in this company discussed potential barriers to encouraging this kind of activity, particularly the risks it presents with regard to health and safety;

> *“I think that depends on how they make up the benches, ‘cos I’ve seen some benches on site which are cobbled together with a couple of pallets and a bit of wood so that you wouldn't even wanna put a cup of coffee on top”*
>
> and
>
> *“they can be very creative, but sometimes they can be too creative, like when they’re trying to balance on top of a big roll and get up a set of ladders”*

(Domestic build company focus group)

Tools and machinery

Workers from the domestic build and civil engineering companies had talked about the benefits of using heavy machinery to save on manual labour and suggested that more of these machines should be made available on site. They also discussed the ‘trigger times’ on heavy, hand-held machinery to prevent symptoms of hand-arm vibration. Stakeholders in the domestic build company agreed that their workers and the contractors buy themselves the best tools that they can afford for the job. Stakeholders in the civil engineering company discussed the pitfalls of using hand-arm vibration (HAVs) trigger times on tools and felt that a potential barrier was that they believed workers often fabricated the length of time they had spent using the tools, to ensure that the job was completed on time. A way of reducing the likelihood of this was to keep procedures as strict as possible, by questioning the workers on the forms returned to the supervisors, when there was a suspicion of spending longer on the tools than they should;

> *"it's hard to police, we struggle…unless you're actually physically timing each person on site on the tools there's a level of trust…there are times where we question HAVs returns and challenge them because they're not realistic to the job they're doing"*

(Civil engineering company focus group)

Stakeholders within the civil engineering company focus group were very interested in the specific suggestions from their workers regarding machinery as this had not been discussed in the workplace before. This presents another need for better communication between managerial staff and the workforce on this site.

Another barrier identified by stakeholders in the civil engineering company was clients who 'go after efficiency', making it difficult for companies to effect change whilst competing to keep the prices of their contracts as low as possible. Interestingly, money and budget constraints were rarely mentioned as a barrier by stakeholders in any of the focus groups, with the exception of better quality PPE and a higher standard of facilities.

An important opportunity for change across all three construction organisations was the need for better communication, interestingly between the stakeholders (in the focus groups) and also between supervisors and the workforce as a whole. Some changes suggested by the workforce could be easily enforced such as toilet facilities however others would be more difficult for logistical reasons, such as employing apprentices. These barriers, such as lack of work for apprentices and concerns about vandalism of welfare facilities and opportunities such as budget incentives for PPE and the improvement of toolbox talks could be potentially be relayed and discussed with the workforce in order to encourage further idea generation and also to build trust between the workforce and the managers.

5.7.3.3 Moving forward

After discussing the opportunities and barriers to the changes suggested by their workforce, stakeholders from all three construction organisations were presented with a number of different ways change has successfully been effected in the industry. Examples of these are the London Olympic 2012 'Porridge' campaign, which provided workers with a free breakfast if they were on site early in the mornings and 'Constructing Better Health', a national membership scheme for better occupational health in the construction industry.

In the focus groups, stakeholders were encouraged to consider ways in which they could effect change within their organisations, ways to engage with their workforce and ways to encourage future idea generation to facilitate healthy working behaviours, healthy ageing and longer working lives in the industry. Figures 28 and 29 show examples of the brainstorming under the theme of 'moving forward'.

Figure 28: Example of brainstorming sheet of ideas to move forward from stakeholders in the civil engineering company

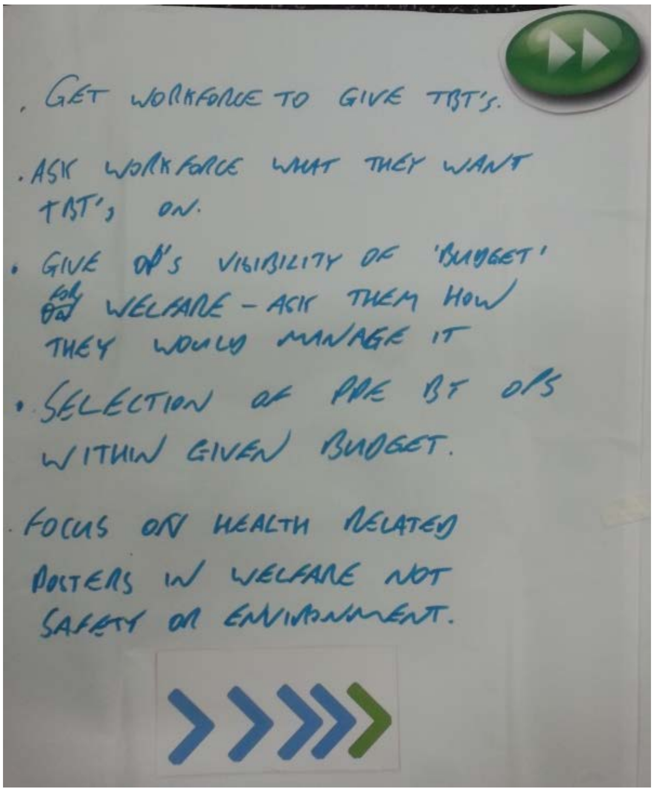
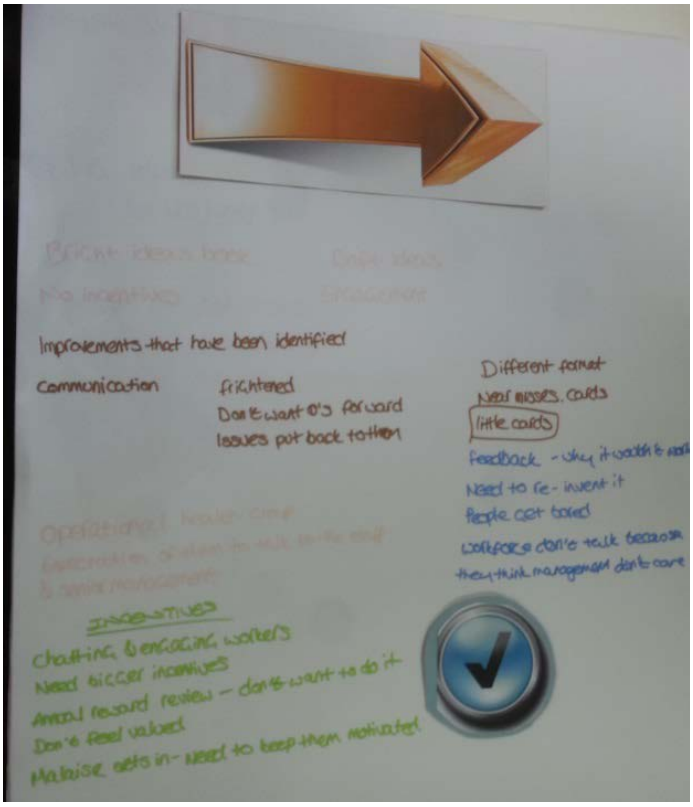


Figure 29: Example of brainstorming sheet of ideas to move forward from stakeholders in the maintenance facility



Stakeholders in all three organisations took the time to seriously consider the ideas and suggestions from their workforce. A total of 150 references were made about 'moving forward'. Figure 30 illustrates an example of the thematic analysis for this theme; from an initial read through of the focus group transcripts, a number of sub-themes were developed based on the popularity with which they were discussed such as feedback methods, improvements to facilities, miscellaneous ideas for moving forward which were not repeated enough to form their own theme, and improvements to PPE.

Figure 30: Example of thematic analysis of focus group transcripts

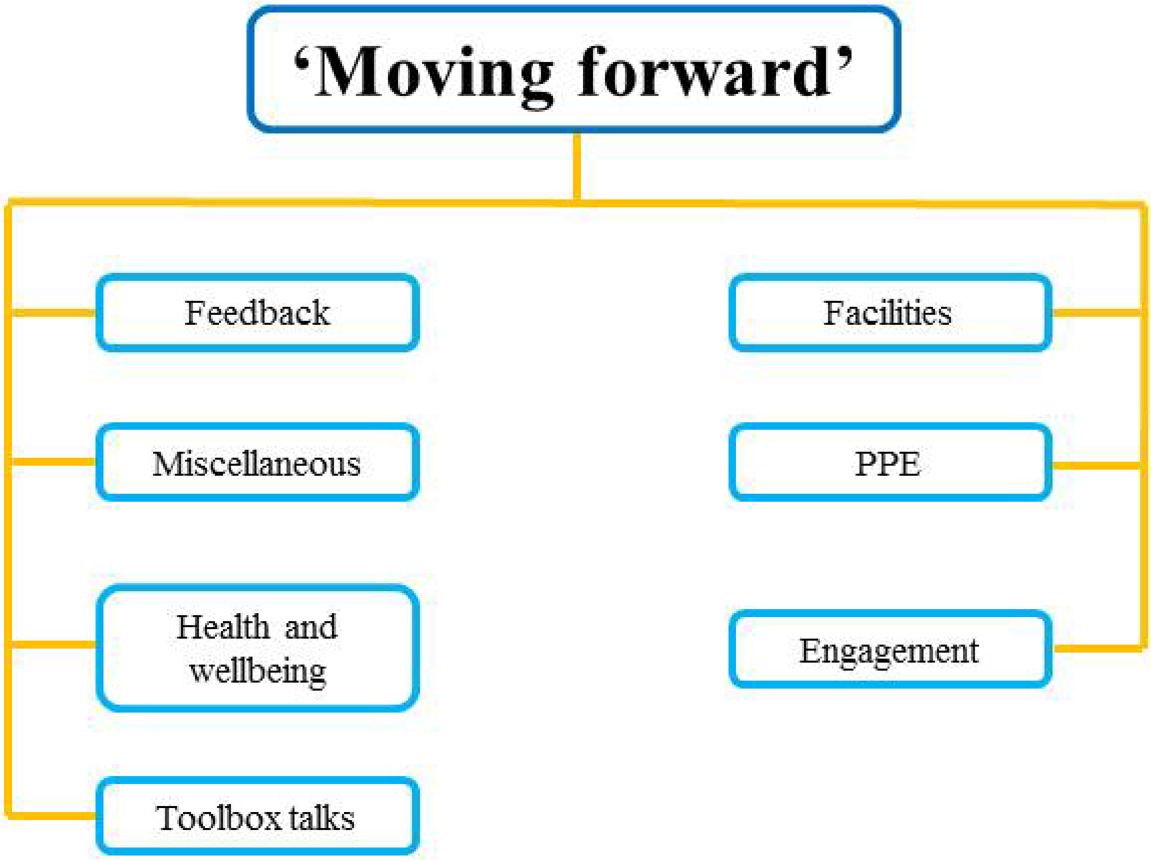


Table 32 presents a summary of the ideas that the stakeholders felt had the potential to be followed up and how.

Table 32: Summary of the changes that stakeholders felt had potential

Company	Suggestion	Potential changes
Civil engineering company	More toilet rolls	Buying large re-fillable wall dispensers
	Better hot water	On-demand heaters or better boilers
	Better toilet facilities	Check-list to ensure facilities are well-maintained
		Anti-vandal/timber toilets to prevent damage
	Increased occupational health on site	On-site van providing staff medicals (only available to staff directly employed by the company)
		Visits from charities i.e. MacMillan skin cancer campaigns
	PPE	Workers having options of PPE brands
	Toolbox talks	Asking workers about toolbox talk content
		Workers presenting toolbox talks
Domestic build company	Better facilities	More money for better welfare facilities
		More money for site appearance
		More shower blocks for workers
		Making a better 'first impression'
	Better health and wellbeing initiatives	Free porridge on site for those who are at work before 07:30 (available on another site)
		Healthier food choices in the canteen
		Becoming a member of a scheme such as 'Constructing Better Health'
		Occupational health nurse site visits
	PPE	More discussions around different PPE brands
		Raising awareness of different kit available
		Specific requirements to contractors re: PPE
		Better value PPE that lasts longer e.g. boots
		Encouraging workers to take ownership of PPE
		Upgrade options for PPE
	Toolbox talks	More visual, touchy feely and interactive
Maintenance facility	Health and wellbeing initiatives	Bigger discounts for staff for gym memberships

Feedback

The most frequently referenced way of 'moving forward' by stakeholders across all three focus groups was to have better 'feedback' (35% of references, *n=52*). 42% of these references were made by stakeholders in the civil engineering company (*n=22*), 33% by stakeholders in the maintenance facility (*n=17*) and 25% by stakeholders in the domestic build company (*n=13*).

Stakeholders in the civil engineering company discussed various methods of feedback currently in place within their workforce; however it was acknowledged that these methods were not necessarily successful. One stakeholder in this company suggested that the regular 'committee meetings' made up of trades' workers and supervisors, held on a bi-monthly basis would be a good opportunity to encourage workers to share their ideas. A second method of feedback, already in place on this site, was a 'welfare noticeboard' however stakeholders admitted that this did not currently engage their workers. Problems with this were workers 'not bothering to check it', 'too much safety information' and 'blue hats' (supervisors) not updating the information regularly, creating a lack of current and relevant information. Senior stakeholders were concerned that the welfare board had 'become wallpaper' to the workers due to the amount of health and safety information posted (unrelated to 'welfare'). An opportunity to move forward was 'to give the guys a break from it' and ensure that information on the welfare board was not related to site safety.

Some stakeholders wondered if a better method would be to use a 'feedback box' which had been used previously on their site. Stakeholders recognised the importance of 'feeding back on the feedback'; they were aware that this was an issue that needed to be addressed, so that workers were confident that their ideas and their feedback were being taken seriously. This 'feedback' was also identified as an important stage of moving forward by stakeholders in the domestic build company; workers who put forward their ideas were often not given encouragement or feedback. This was felt to have contributed to a decrease in engagement with the workforce; many managers were also perceived as having a 'lack of appetite' for suggestions and change;

> *"it's not just fear, it's also lack of appetite, I don't mean from the people making the suggestions but the reaction to the suggestions, too often there's been good ideas that have just been cramped"*

(Domestic build company focus group)

> *"how do you actually feedback on the feedback…they just basically feedback at a higher level, that doesn't mean the card doesn't get actioned, but it doesn't go back to the actual person"*

and

> *“when we’ve asked them before why they don't put more cards in their feedback they've said because they think nothing’s gonna get done”*
>
> (Civil engineering company focus group)

This ‘lack of appetite’ was discussed further, with stakeholders in the domestic build company admitting that when ideas are presented to them, their response is sometimes ‘we don't do it like that’ or ‘we’ve never done it like that’. These discussions led to stakeholders realising that to move forward, supervisors and managers need to be more open to suggestions in order to build trust between them and the workforce.

Stakeholders in the civil engineering company discussed a method of feedback currently in use with their workforce; competitions involving ‘league tables’ for workers reporting safety-related near-misses. However sub-contracted workers had not expressed much interest in taking part in the competition due to them being on site for less than 12 months and ‘not being bothered’, despite monthly prizes of vouchers being offered. Similarly, stakeholders in the domestic build company had previously offered incentives to their workers such as prizes to ‘the best performing subcontractor or operative on site’ however it was acknowledged that the prize of a ‘free fry up’ was not conducive to a campaign to encourage health, wellbeing and healthy ageing at work.

Stakeholders in the civil engineering company also suggested that there was the opportunity for short discussions to be held during morning meetings before work on site starts, allowing idea and issues to be raised and shared. The importance of supervisors was identified here, as workers do not always interact with site managers however they see their supervisors on a daily basis. Stakeholders from this organisation also suggested that to effect change and encourage workers to consider their health and wellbeing at work, having a dedicated occupational health professional on site at all times could help, to provide direct, instant and relevant feedback;

> *“having a dedicated person there all the time sort of encourages that kind of reporting of accidents and injuries”*
>
> (Civil engineering company focus group)

It was interesting that stakeholders in both the maintenance facility and domestic build company acknowledged workers' fear of job loss as a barrier which could prevent workers from suggesting ideas for change to their workplaces. Stakeholders in the maintenance facility felt this identified the importance of building trust between the workforce and management to encourage idea generation. Stakeholders in the domestic build company admitted that this was an issue throughout the hierarchy of the company and that this also prevented site managers from suggesting changes to their superiors and therefore a barrier for engagement which is industry-wide;

> *"it's not just workers I'd say it's even further up"*
>
> (Domestic build company focus group)

> *"sometimes people are frightened to come forward, people don't want to put the questions over because they think they're being silly…if they put it over to that particular person, they know it's not going to go any further because that person's going to say 'well that ain't important to me'"*
>
> (Maintenance facility focus group)

The manager of the maintenance facility acknowledged that to move forward with feedback methods to encourage idea generation from the workforce, these methods would need to constantly be 'reinvented' to ensure that malaise does not set in and that workers don't tire of the process. These stakeholders discussed avenues of communication that have already been created within the facility to encourage health and wellbeing within the workforce;

> *"we have the operational health group, there's an avenue there and an expectation on those guys to talk, it's designed to make that link between the staff that we employ and the management"*
>
> (Maintenance facility focus group)

These avenues of communication included the use of a 'bright ideas book' in which workers can write down their ideas and suggestions for change. However, one stakeholder claimed that people come up with 'daft ideas', reinforcing the issue of mistrust between the workforce and management.

Facilities

17% of references about 'moving forward' were related to the improvement of facilities on site (*n=26*). References were made by stakeholders in the civil engineering and domestic build companies; no stakeholders in the maintenance facility discussed moving forward with their facilities as this was not an issue raised by their workforce. Those from the civil engineering company spoke about following up with the suggested improvements for toilet facilities, such as buying 'big wall dispensers' for toilet rolls to prevent workers stealing whilst simultaneously ensuring an adequate supply, buying better quality toilet seats to prevent them from breaking and ensuring regular checking of the facilities to keep them clean and tidy. Stakeholders in the domestic build company discussed improving site appearance to give a better 'first impression' of their sites and improving welfare facilities to make the workers feel that they are valued.

PPE

11% of references about 'moving forward' were made by stakeholders in the domestic build and civil engineering company about PPE (*n=17*). Stakeholders from the maintenance facility did not discuss future plans for PPE as they accepted that some of their workers were happier with homemade equipment such as knee pads. Stakeholders discussed moving forward with improving PPE based on ideas from their workforces such as choice from a range of PPE, raising awareness of the different PPE available or creating specifications for sub-contractors who work on their site to provide certain brands to ensure quality.

> *"if they have the option of which ones they can pick and stuff that helps, like with the gloves and glasses and things"*
>
> (Civil engineering company focus group)

> *"I know for a fact* [sub-contractor] *will buy the cheapest gloves on the market…the steel fixers have a new pair of gloves every single day…as a company we are getting bigger and bigger and we're getting that much in the market now if we was to stipulate to the subbies, 'right you supply these gloves or you don't work for us"*
>
> (Domestic build company focus group)

Health and wellbeing

11% of references made were about the health and wellbeing of the workforce (*n*=17). Stakeholders in the maintenance facility discussed the importance of 'buy in' from managers and staff regarding health surveillance in their workplace; they believed that for this to be achieved, more health staff needed to be employed to increase the level of trust between them and the workforce. Stakeholders were also keen to investigate the opportunity of providing workers with further discounts for gym memberships, as the benefits of healthy lifestyles improving performance at work are well documented. Stakeholders in the civil engineering company discussed the potential increase for medicals to be carried out on site to encourage the workforce to consider their health within their trades; this was initially offered to direct employees of the company however it was later extended to all workers on site (including sub-contractors). An additional health focused idea from these stakeholders was to have visitors from external charities and companies present campaigns to the workers to increase awareness of the health risks of working on site that they may not have otherwise considered. An example was given of MacMillan presenting skin cancer campaigns; this had actually resulted in a worker being diagnosed with skin cancer therefore the stakeholders were very keen for these initiatives to be continued. Stakeholders in the domestic build company also spoke about moving forward with health and wellbeing initiatives with their workforce, including the introduction of more frequent and varied healthy food options in the on-site canteens and the potential employment of an occupational nurse to visit the different sites within their company. They also discussed the potential of providing a free breakfast to workers on-site early in the mornings, as this was happening across other sites.

> *"I think the safety gets looked at, the environment gets looked at but the health doesn't"*
>
> (Civil engineering company focus group)

> *"a lot of* [workers] *don't go in there now 'cos they'll go up to the supermarket and buy bowls of fruit and stuff like that…she* [new chef] *changed the menu and varied it and put salads and stuff like that on and all of a sudden takings started to go up again"*

and

> *"it could be the other way round and it would be that we employ an occupational health nurse to just tour round the sites, keeping them all in tact"*

(Domestic build company focus group)

Engagement

Improving the engagement of the workforce was considered across all three focus groups (8%, *n=12*). Stakeholders discussed the importance of encouraging idea generation and idea sharing, how to get workers thinking about their health and wellbeing at work, and ageing in their trades in general. Stakeholders in the domestic build company spoke about 'changing the mind-set' of the workforce to get them sharing ideas about health, wellbeing and ageing and stakeholders in the civil engineering company identified the need to 'work on their engagement' and how they deliver these changes. The manager of the maintenance facility spoke of his concern about the 'general malaise' of workers, meaning that they were not interested in talking to supervisors about their ideas and suggestions for change to improve the ways in which they work. Stakeholders in this focus group discussed an annual 'awards night' that is held for the staff however there was the impression that the workforce felt the 'money could be better spent' and as a result the event was poorly attended. This suggests that supervisors and managers need to work closer with the workforce in order to better understand their needs.

> *"we just need to work on our engagement, we need to change the way people look at things and see how we can actually deliver it"*

(Civil engineering company focus group)

> *"we have to change peoples' mind-sets don't we? And the only way we change their mind-sets is by getting them talking about it"*
>
> and
>
> *"it's just a big cultural thing really isn't it because construction has always been very 'stop, tell, do it this way or it's the highway' so it's that change"*

(Domestic build company focus group)

Toolbox talks

Stakeholders from all three focus groups discussed the future of toolbox talks (4%, *n=6*). They intended to increase engagement of the workforce by asking workers what topics they would like or recruiting experienced workers to present relevant ideas or experiences. Stakeholders in the domestic build company were equally keen to improve the engagement of their workforce by introducing more interactive toolbox talks such as using flashcards or simulations of some of the injuries and health problems which could compromise the work ability of their trades' people on site.

> "*maybe one thing to move forward is, rather than us deciding what the toolbox talk is for that week, is to ask the week before 'right guys, you know we're gonna have a toolbox talk next week, what do you want it on?'*"

(Civil engineering company focus group)

> *"I despise toolbox talks in their current form and we've already mentioned about doing more visual, touchy feely stuff…we've got some flash cards coming out which are pretty graphic and we've introduced a simple test on the back of the cards so we say, tuck your thumbs inside your palms try and do your shoelaces up"*

(Domestic build company focus group)

In addition to this, stakeholders in the maintenance facility discussed bringing visitors in to give more impactful talks; an example was given of workers who have been blinded in accidents, which had been successful in terms of the 'shock factor' however stakeholders were unsure of how to continue this level of impact after the initial 'shock' has worn off.

Miscellaneous

Other ideas for moving forward were also identified but not repeated enough to form their own themes (13%). These were building upon existing campaigns such as 'what difference can you make today' on the domestic build company's sites and introducing campaigns such as 'ban the broom' which requires 'everything to be vacuumed up', decreasing the amount of dust and risk of respiratory disorders.

Stakeholders in the maintenance facility acknowledged the benefits of a ‘bottom up approach’ involving the workforce from the beginning rather than making decisions and informing the workers afterwards. They also discussed how to encourage their workers to share their ideas and experiences with each other;

> *“I do believe that the best way of doing this is actually getting the bottom up, for a lot of things”*
>
> and
>
> *“you want that health and wellbeing and ageing discussion out there in the workplace…we have a group of people that represent that workforce…I think there’s a disconnection there about what they feel their roles and responsibilities are…so it’s how we can use this information”*

(Maintenance facility focus group)

A barrier to moving forward by the industry in general was captured by a stakeholder in the civil engineering company; the segregated nature of the workforce, with multiple workers belonging to various sub-contractors, coupled with the peripatetic nature of construction work mean that workers are usually not on site for longer than 12 months at a time and can present difficulties in terms of encouraging buy-in;

> *“because it’s not a single workforce, I think our workforce is quite segregated because we’ve got a workforce that’s split by different subcontractors…if we had an entirely* [directly employed] *workforce it would be much better to get buy in*

(Civil engineering company focus group)

The head of human resources in the domestic build company was also concerned about the lack of measurable dependent variable when encouraging engagement of the workforce;

> *“what I’m worrying about with some of the ideas you’re talking about, on the surface they just sound intuitive and would be really good if they give people the experience but how do you actually measure whether, would it just be the overall accident rate ten years from now?”*

(Domestic build company focus group)

5.8 Discussion

A focus group study was conducted to explore senior construction stakeholders' perceptions of older workers and investigate barriers and opportunities to change within the industry to improve and encourage healthy ageing, awareness of health and wellbeing and longer working lives in trades. In this section, the most important findings in relation to the objectives will be discussed in the context of the literature, followed by the limitations of this study and the conclusions.

All stakeholders across the three construction organisations were keen to hear the ideas suggested by their workforces. They gave serious consideration to the suggestions and rationally discussed the opportunities to effect change within their companies based on these ideas. These positive attitudes present a strong basis for the use of participatory approaches in construction, which can utilise the experience, knowledge and creativity of the workers to encourage healthy ageing and working behaviours. Previous research has shown that when supervisors and managers involve the workforce in decision making for change, positive interventions can be achieved in the construction industry. For example, in a study by Kramer et al., (2009) workers in a manual trade company identified the task of taking ladders on and off roofs of service vans as high risk for the development of musculoskeletal disorders. To overcome this they suggested the use of a hydraulically operated ladder rack which was found to reduce low back loading therefore reducing the risk of musculoskeletal disorders. In another construction company, the idea of a 'tool tree' was proposed, to make heavy tools easier to reach by carpenters working in a shop (Moir & Buchholz, 1996). This idea has a number of benefits, such as reducing trip hazards by removing tools from the floor and reducing the need for workers to bend and stretch to reach their tools which decreases the risk of musculoskeletal disorders (Moir & Buchholz, 1996). When managers and supervisors encourage idea generation from the workforce and the end-users, often the most useful and practical solutions to problems in trades are found (Wilson, 1995a; Loch et al., 2010).

Overall, stakeholders in these construction organisations were very positive about older workers, contradicting previous research findings that suggest employers may behave prejudicially towards them (Loretto & White, 2006a). They showed an appreciation for older workers and highly valued their experience and knowledge developed through spending many years in their trades. Positive perceptions, including older workers being more loyal, reliable, respectful and producing work of a better quality were consistent with findings of previous research studies (Siu et al., 2003; Lombardi et al., 2009). However, despite negative perceptions of older workers being less commonly referenced by the stakeholders (e.g. the slower pace of workers, the lack of co-operation with site regulations), they have also been found in previous research (Loretto & White, 2006a; Williams et al., 2011). Many benefits of retaining older workers in the construction industry were also identified by the stakeholders, such as the potential for knowledge and experience transfer to younger workers, echoing findings of recent research (Kooij et al., 2014). This study also identified that older workers could feel additional responsibility and feel more valued when they pass down their knowledge to younger workers. Using older workers as mentors for younger workers in manual trades is seen as a huge benefit; it has been suggested that younger workers appreciate the advice given to them by older workers (Lombardi et al., 2009) and that by transferring this knowledge and experience, the risks of work-related ill health could be significantly reduced for the younger generations of manual workers (Williams et al., 2011). This type of practice is also being used successfully across a variety of industries worldwide; a Swedish organisation has taken active steps to retain the knowledge and experience of their older workers by adopting “parallel duty” for older and new workers, where a new trainee will work alongside an older worker to ensure relevant and essential knowledge and skills are transferred (Taylor, 2006).

Throughout discussions for change with stakeholders in all three construction organisations, the need for better communication quickly became apparent. Stakeholders were unaware of some of the issues experienced by their workers suggesting the lack of avenues for workers to raise concerns. There was also confusion between stakeholders in organisations about whether current changes had been implemented, successfully or otherwise. Often stakeholders came up with valid, unavoidable barriers to changes suggested by their workers, such as the logistical difficulties of completing apprenticeships in the maintenance facility. These easily be relayed to the workforce, reducing confusion and relieving the concerns of the workers This demonstrates the importance of involvement from stakeholders at all levels, such as trades’ workers, supervisors, managers and industry experts to ensure appropriate decisions are made. The importance of this involvement has been acknowledged in previous research (Wilson, 1995a; Choudhry & Fang, 2008) where despite encouraging involvement of the workforce, ‘management retains the right to take action or not’ (Haines et al., 2002). The first line of Phelps & Horman’s (2010) research paper reads: *“ineffective communication between project team managers, lack of trust, inadequate adoption of new technologies…are some of the most critical issues affecting all aspects of the construction industry today”*. Construction is an industry which has previously been known for its poor communications (Love & Edwards, 2005; Yitmen, 2007) which can contribute to accidents and work related stress (Andriessen, 1978; Abbe et al., 2011). Previous research has also identified the importance of good communication between teams of workers in order to ensure successful intervention and change (Shaw et al., 2006; Rivilis et al., 2008; van Eerd et al., 2010). It has also been shown to be an excellent way of sharing “know-how” within the workforce (Kramer et al., 2009). Introducing change and interventions in the workforce have been shown to improve communication in construction by encouraging workers to discuss the effects of the changes and to feedback how they could be improved (Yitmen, 2007; Rinder et al., 2008) however for communication to improve, adequate channels must already exist to facilitate discussion between the workforce and management. These previous research findings suggest that for the knowledge and experience of workers to be harnessed, for ideas to be generated and for change to be effected, communication across all levels of construction organisations is essential.

Although stakeholders were open to considering changes suggested by their workforce, a number of barriers were identified; clients ‘go after efficiency’ meaning that they are not concerned about paying for health and wellbeing initiatives for the workforce or having higher standard facilities on site. The peripatetic nature of the workforce means that workers are rarely on site for a long enough period of time for ideas to be generated and for changes to be successfully implemented. Stakeholders also felt that workers showed a lack of care and respect towards facilities, creating a barrier to spending more money on them. Similar barriers to change have also been identified in previous construction research studies; Moir & Buchholz (1996) identified the strict economic margins in construction causing contractors to be resistant to change. In addition many previous studies have identified the problem of the constant development of construction sites meaning that workers are never around for long (Moir & Buchholz, 1996; de Jong & Vink, 2000; Kramer et al., 2009). Although the senior stakeholders claimed that workers do not respect the facilities enough to justify spending more money on them, there is no research evidence to support these perceptions. An additional barrier to suggesting change was fear of job loss, which was identified by both the workers and the stakeholders in construction organisations. Previous research has also found similar issues, with workers fearing negative retaliation if they ‘complained’ (Roelofs et al.,2011) or if their suggestions were negatively perceived by their peers (Kramer et al., 2010). Interestingly, cost was not mentioned as a particularly important barrier with the exception of hiring additional occupational health staff and purchasing better PPE. These findings contradict previous research, which has suggested through interviews with workers that financial constraints are a big problem when considering interventions and change in the industry (Leaviss et al., 2008a; Pehkonen et al., 2009). The barriers identified by the stakeholders in the focus groups are consistent with those found in the literature suggesting that these are historical problems in the industry where change is difficult. Nevertheless, countless changes and interventions have been made in construction despite these barriers, such as new devices for bricklayers (Hess et al., 2004), mechanical aids for glaziers (de Jong & Vink, 2000), a therapeutic exercise programme for construction workers (Ludewig & Borstad, 2003) and the use of pneumatic wall lifts and extension handles for tools (Mirka et al., 2003) meaning that these can be overcome with the correct approach.

Opportunities for change concerning the health and wellbeing of their workforces and retaining older workers were enthusiastically discussed by stakeholders in the construction organisations, suggesting a high level of motivation. Senior stakeholders were keen to retain the knowledge and experience of older construction workers and identified opportunities such as inviting them to hold toolbox talks and share their experiences with younger workers. It was felt that the involvement of members of the workforce in toolbox talks may encourage engagement and increase understanding of the risks to health and wellbeing in their trades. Previous research has shown that interactive toolbox talks can lead to an increase in safe behaviour (Kaskutas et al., 2013; Gross, 2015). Additional opportunities identified by the stakeholders to improve the health and wellbeing of the workforce, which in turn would encourage longer working lives included increasing the choice of healthy foods in the canteens on site, offering discounted gym memberships and improving provisions of hot running water, which have been shown to be essential, yet often over-looked aspects of workers' wellbeing (Whysall et al., 2007).

Stakeholders were also very receptive to suggestions from their workforce regarding the facilities on site. An important opportunity was discussed to improve changing rooms, toilets, canteens and welfare facilities. Historically, facilities on construction sites are well known for being kept in extremely poor conditions, being blamed for outbreaks of disease such as ringworm in the Victorian era (Magnuson, 1961) and 'Rethinking Construction' (1998) claiming that facilities on construction sites are 'typically appalling'. It was also very encouraging to see that stakeholders wanted to put aside more money for 'site appearance' which has previously been considered to be a factor contributing to school leavers perceiving construction work as 'dangerous and dirty with poor prospects' (Tookey & Chan, 2001). Tookey & Chan (2001) also claimed that "an improvement in the conditions of construction sites would present a better image of construction and have a positive effect on recruitment into construction"; this may in turn, improve the concerns expressed by the stakeholders in this study about the lack of younger workers coming into the industry. The enthusiasm and foresight of construction stakeholders' discussions of opportunities to act on suggestions from their workforces provides strong evidence that with management buy-in, change can be effected in the industry to encourage workers to continue to share their ideas and facilitate healthy working behaviours.

This enthusiasm and positivity was once again demonstrated when stakeholders in all three organisations made consideration suggestions as to how they could continue to encourage the engagement of the workforce through the use of competitions and incentives, idea books and boxes and welfare notice boards. Many of these methods have been used in previous research studies in addition to 'solution sessions' to assess risky behaviours with workers before identifying potential solutions (Vink et al., 1997; de Jong & Vink, 2002; Loch et al., 2010). Another important idea from the stakeholders was to implement better methods of feedback to ensure their workers remained engaged. A lack of feedback has been shown to be a cause of work-related stress and job dissatisfaction (Hinzelman & Smallwood, 2004; Love et al., 2010). Feedback has been shown to be incredibly important when using participatory approaches involving workers to ensure they develop a level of trust with supervisors, so that they feel all of their ideas are being listened to and seriously considered and also so that they realise why the changes are being made (Laitinen & Ruohomäki, 1996; Vink et al., 1997; Lombardi et al., 2009; Loch et al., 2010). With recent advancements in technology and the increasing popularity of smart phones and tablets, construction supervisors and managers have a wider variety of methods to both encourage feedback from their workforces and to provide feedback to them; Davies and Harty (2014) analysed the use of an interactive mobile app which enabled employees to submit, share, discuss and develop ideas. During the first ten months of operation over 200 ideas were submitted suggesting that this method could potentially be used in a wider number of construction organisations. However it is important to consider the accessibility of such devices and whether they would be used by a large enough number of the workforce to be deemed effective in yielding enough comments and feedback from the workforce to effect change.

It was interesting to note that the civil engineering company, who were the largest organisation involved in this research, identified considerably more opportunities for change to improve the health and wellbeing of their workforce in comparison to the smallest organisation, the maintenance facility. Although money was not considered to be a particularly important barrier for any of the stakeholders, it was clear that the civil engineering company were able to offer their workforce more in terms of opportunities to improve their health, wellbeing and healthy ageing at work such as visiting medical vans and talks from charities to increase awareness of health at work as a result of having a larger budget. Stakeholders in the maintenance facility had expressed their disappointment at the difficulties they had experienced when trying to attain discounted gym memberships for their workers, which had been declined due to budget cuts within their organisation. These differences highlight the restraints experienced by some organisations when considering change and intervention to improve health, wellbeing and ageing in the workforce. However it is also important to acknowledge that all stakeholders in all organisations were open to suggestions from their workforce and were keen to move forward with their ideas despite potential barriers.

5.9 Limitations

Stakeholders were selected using a purposive sampling strategy due to the specific requirements of the focus group discussions i.e. they could provide appropriate contributions to discussions about the health, wellbeing and ageing of their workforce and the opportunities and barriers for change. As the researcher was not aware of the number or occupations of staff members within each organisation, the main contact within each organisation was asked to select appropriate stakeholders for the focus groups. This may have created a biased sample, although care was taken to ensure that the inclusion criteria were clear to the contact. Despite the potential for a biased sample, there were no stakeholders in the focus groups deemed inappropriate for the discussions held.

The head of human resources in the domestic build company expressed the concern of how the benefits of changes could be measured; this has also been raised in previous research with respect to the efficacy of interventions (Sorensen et al., 2006; Jensen & Friche, 2007). As specific changes had not been introduced, there was no way of measuring any effects, however there have been several research studies which have provided sound evidence of engagement of the workforce producing relevant and practical ideas to reduce risks such as musculoskeletal disorders and fatigue at work (Vink et al., 1997; Loch et al., 2010).

When using focus groups as a method of data collection, there is a risk that individual participants may not have the opportunity to express their opinions and thoughts due to louder members of the group. To minimise the risk of this, stakeholders were provided with post-it notes and the opportunity to write down any additional comments they may have. Despite this option being available, very few participants made use of the post-it notes due to the open nature of the discussions in each organisation, with all stakeholders making extensive contributions.

5.10 Conclusions

The results supported the following conclusions:

- Stakeholders in construction organisations are very keen to hear the ideas and suggestions for change from their workforce in order to improve the health and wellbeing of their workers. They are willing to discuss potential opportunities and barriers for effecting changes with their workforces such as making cheaper changes as quickly as they can. Examples of identified opportunities were improving facilities, provisions of hot water and toilet rolls and improving the healthy meal choices in canteens.
- Stakeholders have mixed perceptions of older workers although these are largely positive. They value the experience, knowledge and loyalty of older workers and acknowledge the benefits of retaining them in the workforce in order to pass on their skills to younger workers. Stakeholders are also aware of the difficulties faced by some older workers such as maintaining a quick pace of work and complying with new health and safety regulations.
- Stakeholders in construction organisations have good ideas about how to sustain engagement of the workforce, such as idea forums, improvements to 'welfare boards' on site, competitions, incentives and various methods of feedback to encourage idea generation and to build a good level of trust between the workforce and supervisors.

Stakeholders demonstrated their concern about the health and wellbeing of their workforce and are keen to make changes wherever possible in order to improve this and in turn facilitate healthy ageing within their trades. Many opportunities and barriers were identified during discussions of the ideas suggested by their workforce providing evidence that some changes may take longer than others and some are not possible at all. A recommendation to facilitate idea generation and engagement within these workforces is to improve communication, so that supervisors and managers are aware of the suggestions workers have and workers are provided with feedback on their ideas. Using participatory approaches and good communication techniques, better working behaviours can be encouraged which in turn could increase productivity, reduce the risk of injury and ill health and encourage healthy ageing.

6. Study Three: building the healthy construction worker workshops

6.1 Introduction

A critical review of the published literature relating to research methods in construction confirmed that, by involving the end user using participatory approaches, positive changes can be successfully implemented within the workforce (Noro & Imada, 1991). Previous research has also strongly recommended that interventions are needed in the construction industry at all levels ‘to reduce the current unacceptably high levels of work-related ill health’ (Leaviss et al., 2008a). By consulting the workforce about the problems and risks they are facing, tangible solutions can be suggested to encourage healthy working and improvements in working practices. These improvements have the potential to reduce the risk of injury and ill health in construction workers of all ages, enabling longer, healthier working lives.

John Wilson (1995a) defined participatory ergonomics as:

> *“the involvement of people in planning and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both processes and outcomes in order to achieve desirable goals”*

Participatory approaches have historically been shown to be successful in a number of industries as well as construction; de Jong and Vink (2002) used a step-by-step participatory approach which included ‘solution sessions’ with installation workers to develop interventions such as a fold out bench in vans to reduce difficult working postures and a transporting device for heavy materials to eliminate heavy lifting. Moir & Buchholz (1996) used participatory approaches with construction workers to encourage ergonomic interventions in a large building project and de Looze et al., (2001) reviewed seven cases in which workers such as scaffolders, bricklayers and roof workers were consulted for the redesign of tools and devices to successfully increase usability and reduce the risk of musculoskeletal disorders. More recently, Entzel et al., (2007) found that many construction stakeholders were aware of innovations in the industry to reduce musculoskeletal risks, suggesting there is a range of knowledge which could be passed within and between workforces to improve health at work. Construction workers have been shown to have good knowledge and experience, built from working in their trades for many years and are therefore ideal candidates for advising potential and practical solutions to reduce the effect of the risks associated with their heavy manual work (Eaves et al., 2015). Hess et al., (2004) acknowledged this unique knowledge held by trades' workers and used this to successfully implement a participatory approach within the workforce which led to a reduction of the risk of low back disorders in concrete labourers. It is essential that this knowledge and experience is not lost and is harnessed and utilised to encourage healthy working behaviours in the industry to ensure workers of all ages can remain in their trades for longer if they so wish. The construction industry is lacking useful resources and guidance to facilitate idea sharing and engagement of the workforce, meaning that this knowledge and experience is often being lost through the retirement and early exit of workers from the construction industry.

6.2 Aims and objectives

The aim of this chapter and of this third research study was to explore senior stakeholders' and trades' workers' views on how a resource to encourage healthy working behaviours to enable longer working lives in construction, could be implemented in the industry.

The objectives of this chapter are:

1. To capture ideas about *what* type of resource would engage the construction workforce to consider their health and wellbeing at work and encourage healthy working behaviours to facilitate longer working lives.
2. To explore *how* a resource could have the most impact in the industry and how it could be implemented to ensure workers and senior stakeholders engage with it.
3. To capture ideas about *who* if any particular workers or senior stakeholders, would benefit the most from a resource encouraging consideration and awareness of health and wellbeing at work to facilitate longer, healthier working lives.

6.3 Sampling

For this research study, a purposive sampling strategy was used whereby participants from the three construction organisations previously involved in this research were contacted and asked to take part in a ‘feedback workshop’. This type of sampling was deemed the most appropriate as it enables the researcher to “satisfy their specific needs in a project” (Robson, 2011) and their previous involvement meant that they would have prior knowledge of the research. The organisations involved were a maintenance facility with one site, several sites within a domestic build company and one site within a civil engineering company. The main contact in each of the three organisations (Director of the domestic build company, the manager of the maintenance facility and the project manager on site in the civil engineering company) was approached via email and asked to invite specific individuals who had previously been involved in the research to take part in the workshop; 2-3 trades’ workers (Chapter 4) and health and safety professionals, project managers and civil engineers (Chapter 5). The researcher was unable to contact specific individuals due to a lack of contact information and the peripatetic nature of construction work meaning that trades’ workers move quickly onto other construction sites. As a result of this, the main contact in each organisation was provided with a list of names of the trades’ workers who had been interviewed in the first research study (Chapter 4); the entire list of workers from the relevant organisation was provided to the contact to ensure random selection as far as possible.

Due to unforeseen circumstances, a considerably lower number of participants attended the workshop than expected. In construction there is a high turnover of staff due to the peripatetic nature of the industry; sites develop rapidly and as a result, workers and supervisors move on to different sites, with trades’ workers often changing employers regularly resulting in often unstable and irregular work (Ringen et al., 1995; Lipscomb et al., 1997). To ensure a wide range of ideas were captured from senior stakeholders and trades’ workers, a further three workshops were held. The researcher asked the main contact from each of the organisations to recruit 4-6 workers from their company to take part in these workshops. Due to the peripatetic nature of the industry, many of the workers previously involved in the research study were no longer available, meaning that a mixture of previous and new participants took part in the workshops

6.4 Study design and rationale

For the initial workshop, the researcher emailed the main contacts with a "Save the Date" notification, followed by an official invite to the event held at Loughborough University Design School. For the additional three workshops with trades' workers, the researcher liaised with the main contact from each organisation to secure appropriate dates, times and locations for workshops to be held. In these three cases, the researcher travelled to the appropriate sites to hold the workshops with the trades' workers.

For all four workshops, participants were given a brief introduction to the purpose and aims of the session and were provided with an information sheet (Appendix A19). They were then informed of their right to withdraw from the study at any time and were reminded that they would remain anonymous throughout the analysis process. The researcher then asked participants to sign an informed consent sheet (Appendix A20) and were also asked for their permission to record the audio of the workshop on a Dictaphone for analysis purposes.

6.5 Workshop schedule

A workshop schedule was developed based on a review of the previous literature and methodologies, and the analysis of the previous two research studies, in which construction workers were found to have good ideas to facilitate healthy working behaviours and senior stakeholders were keen to develop these ideas and encourage their workforce to suggest changes to improve their health and wellbeing at work (Chapter 4 and 5).

Initially participants were presented with a small amount of context and background to the research, including statistics about the ageing workforce in the UK. An ice-breaker exercise was then used to encourage participants to think about ageing; they were asked to write down their favourite band or singer on post-it notes and stick these on a board at the front of the room (Figure 31). The artists written on the post-it notes were then compared to the current 'Top Ten' artists in the UK music chart (Figure 32). Participants were asked if they had heard of, or listened to any of the artists in the 'Top Ten', which facilitated discussion about how people have different tastes and relate to different types of media which can often be dictated by their age and the lifestyle that they lead. This then facilitated discussion about how different types of resource could be received by different audiences in the construction industry. Participants were then presented with some background information about ageing construction workers such as the potential difficulties they may face with manual labour in later life and positive perceptions of older workers in the industry such as their extensive knowledge and experience of their trades.

Figure 31: Example of post-it notes from participants' favourite musician/band

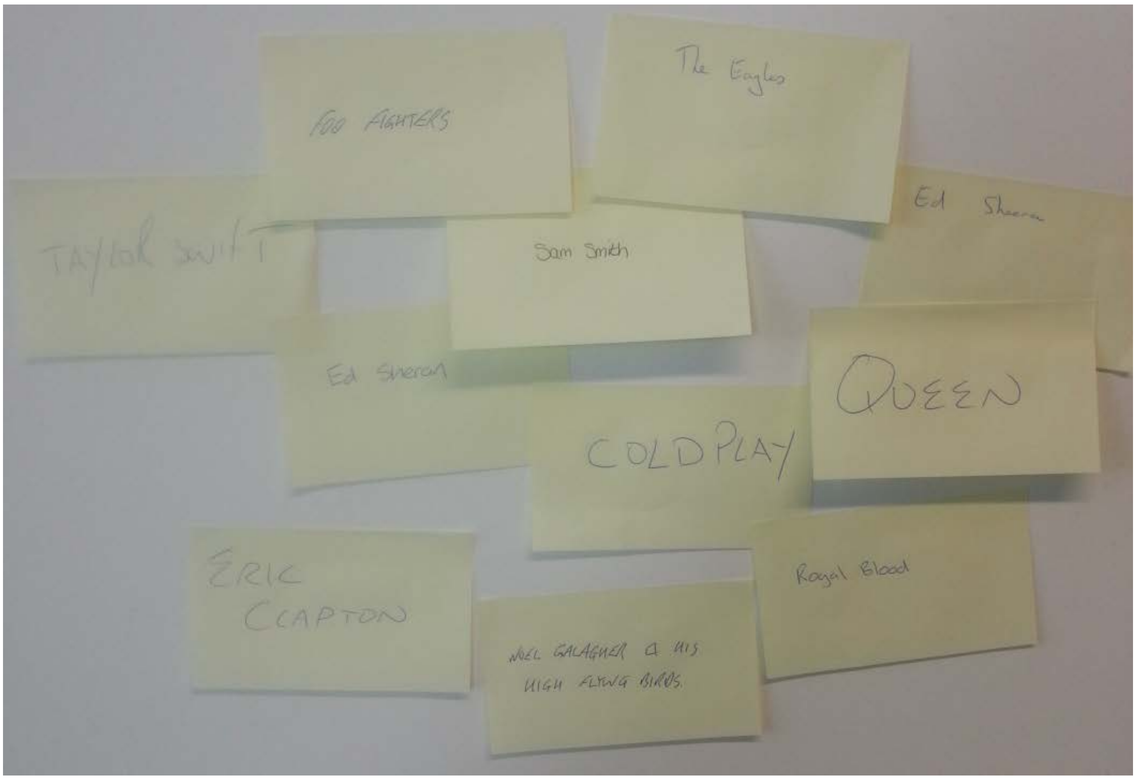
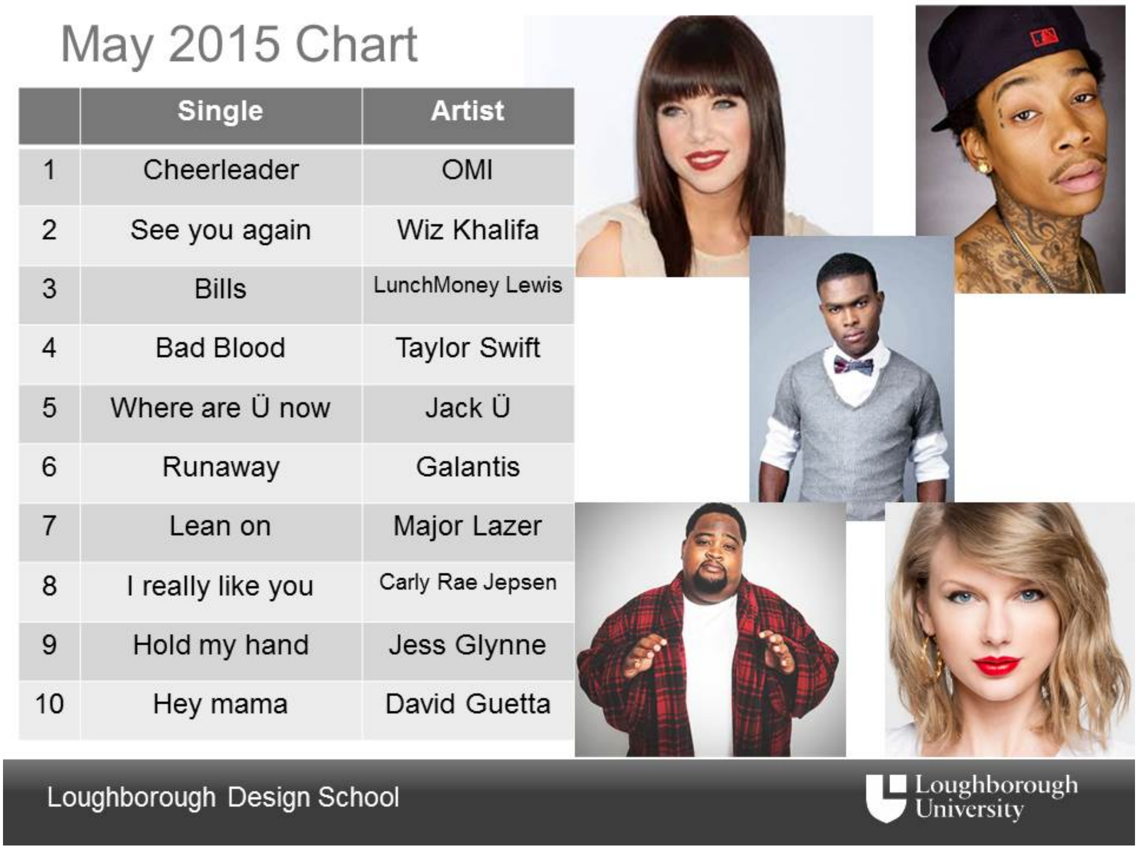


Figure 32: Presentation slide of current UK 'Top Ten' singles chart music



The workshop was then split into four main themes to capture ideas for the development of a resource in the industry to encourage engagement of the workforce and improve awareness of health and wellbeing in their trades to facilitate healthier, longer working lives. The first theme explored the success of ‘previous campaigns’ which had been used to influence change in the workplace and in construction, followed by ‘what’ type of resource could be successful, ‘how’ it could be implemented and ‘who’, if any workers in particular, the resource should be tailored to. Prompts and probes were used as appropriate and the researcher wrote down points made by the participants in order to facilitate further discussion. Participants were also encouraged to write down their ideas and opinions on post-it notes, to ensure all participants were engaged and that all their views were captured.

Participants were also asked to fill out a questionnaire at the end of the session to collect demographic data such as age range, occupation, employer and number of years spent in the construction industry. The questionnaire also served to capture any further thoughts that may have not been expressed during the workshop (Appendix A21). Participants were asked if they were concerned about an ageing workforce, what they thought should be included in the resource, how they thought engagement could be encouraged and what they would say if they had the opportunity to speak to the Government or Members of Parliament about older workers in construction.

A note taker was present for the first workshop due to the high number of participants invited, however due to the location of the subsequent three workshops no note taker was present. To compensate for this, a ‘checking sheet’ (Appendix A22) was filled out by the researcher immediately after the workshop to capture any salient findings or changes that needed to be made for the further workshops.

The structure of the session was significantly modified for the workshops with trades’ workers; the majority of these participants were ‘on price’, meaning that they were paid based on their productivity on site. As a result, the introductory ice breaker session and presentation of background information was considerably shortened. The end of session questionnaire was made optional due to their time constraints and also due to workers saying they did not want to write their responses down. Previous research has found that the literacy skills of construction workers are commonly lower than those of workers in other industries (Wilkins, 2011).

6.6 Data analysis

The audio from the workshops was recorded on a Dictaphone and the files uploaded into NVivo10 software, where all files were transcribed verbatim. These transcripts were individually qualitatively analysed by the researcher using quasi-statistical and template approaches (Miller & Crabtree, 1992). A quasi-statistical approach uses the frequency of references from transcripts to determine the importance of key themes whilst a template approach allows these key themes (derived from an initial read of the data) to be used as a template for data analysis, which can be changed as the analysis progresses. Main themes were identified and then further sub-coded to make them more specific including ‘repeatable regularities’ which indicate the importance of the themes based on their repetition (Miles & Huberman, 1994; Rubin & Rubin, 1995). Quotes are used within the analysis below (Section 6.7.3 onwards) to support and illustrate the findings of the workshops.

6.7 Results

This section reports the outcome of four workshops held with senior stakeholders and trades’ workers from three construction organisations (a maintenance facility, a domestic build company and a civil engineering company) the qualitative data collection and resulting analysis. Demographic data of participants will be presented first, with the workshop results and additional questionnaire comments being reported in line with the four main themes previously discussed (Section 6.5); participants’ experience of previous construction campaigns, ‘what’ type of resource would be most effective, ‘how’ this could be implemented with maximum impact and ‘who’, if anyone, it needs to be tailored to.

6.7.1 Sample

One workshop was arranged to be held in Loughborough University Design School with a total of 18 senior stakeholders and 6-9 workers (2-3 invited from each organisation). However, due to unforeseen circumstances such as stakeholders not being available to take part and sites no longer employing trades’ workers, a total of 5 senior stakeholders took part and no workers.

Due to the small number of participants, a further three workshops were arranged, one in each of the organisations, to ensure a broad range of ides were captured. Due to the peripatetic nature of the industry, many of the workers previously involved in the research study were no longer available, meaning that a mixture of previous and new participants took part in the workshops (Table 33); an additional 18 participants were recruited for these workshops meaning that a total of four workshops took place with a total of 23 participants. Figures 34, 35, 36 and 37 illustrate the process of how participants were recruited. For example, in Figure 34, 18 senior stakeholders were invited to the first workshop via one main contact in each of the three organisations. Those who were unable to attend are highlighted in red.

Table 33: Previous and new participants in workshops

Workshop number *(n)*	Previous participants	New participants
One *(5)*	5	0
Two *(7)*	1	6
Three *(7)*	2	5
Four *(4)*	3	1

Figure 33: Sampling of participants for workshop one (n=5)

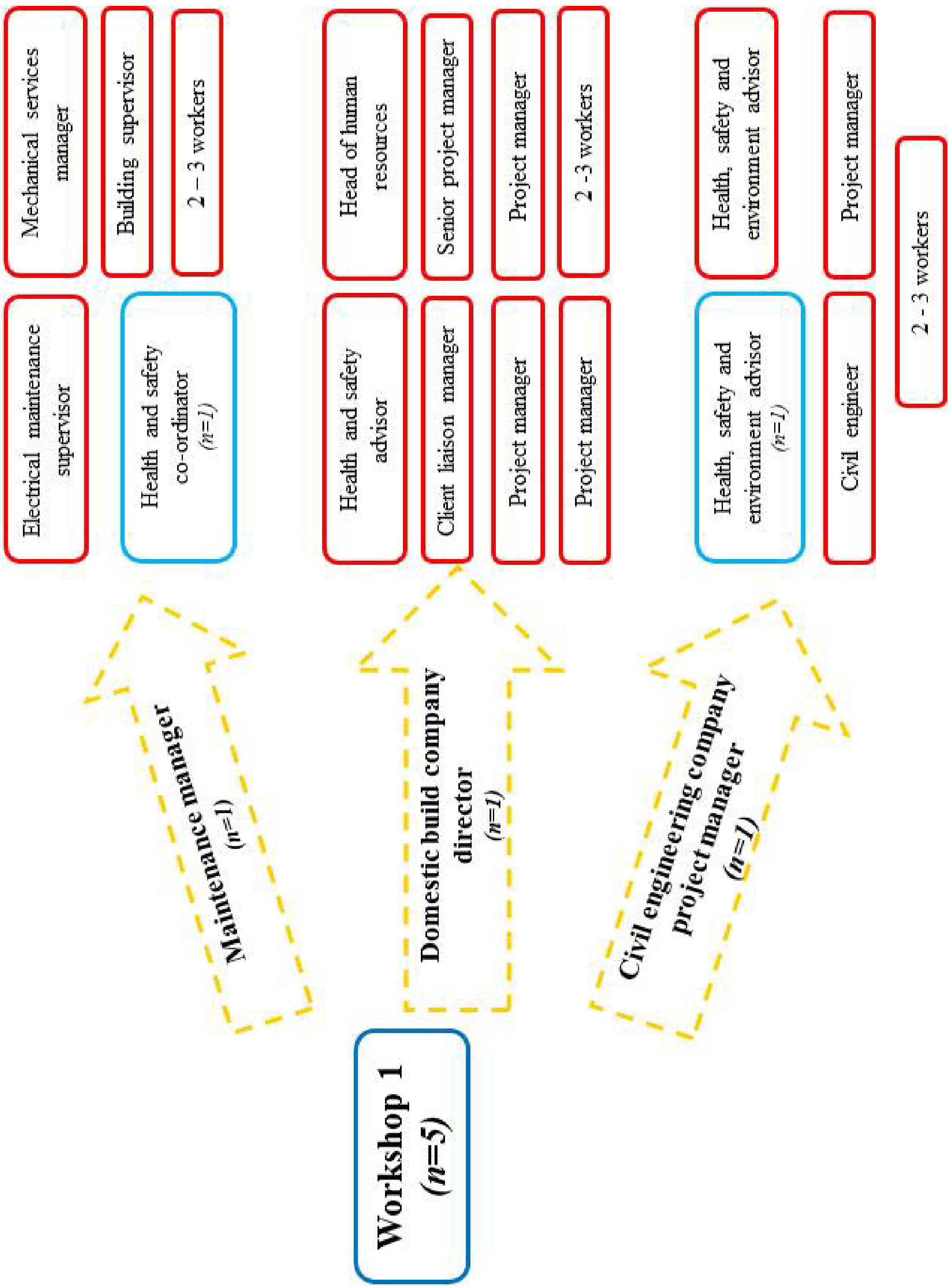


Figure 34: Participants for workshop two (domestic build company) (n=7)

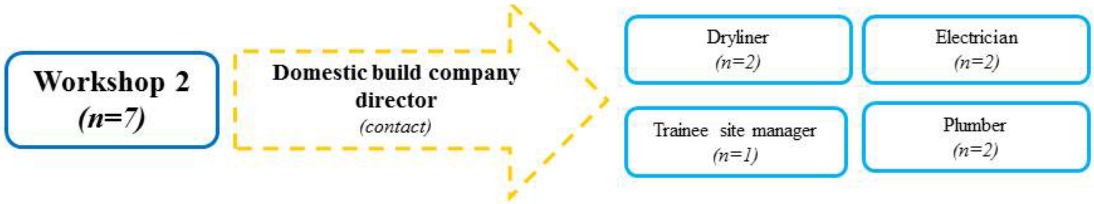


Figure 35: Participants for workshop three (civil engineering company) (n=7)

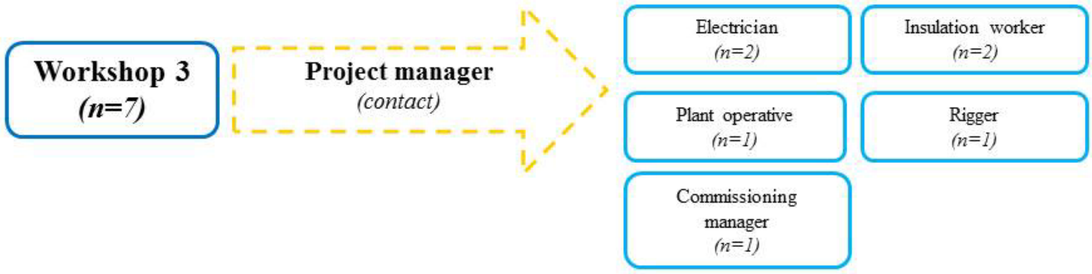


Figure 36: Participants for workshop four, maintenance facility

6.7.2 Demographics

Table 34 shows the occupation, age ranges and length of time spent in industry of all participants involved in the workshops.

Table 34: Demographic data of workshop participants

Workshop number	Occupation	Age range	Number of years spent in industry
One	Health, safety and environment advisor	35-49	10
	Project manager	35-49	26
	Director	35-49	32
	Health and safety co-ordinator	50+	30
	Maintenance manager	50+	40
Two	Site manager trainee	Under 25	1
	Plumber	25-34	1
	Dryliner	25-34	8
	Dryliner	25-34	14
	Plumber	25-34	5
	Electrician	50+	25
	Electrician	50+	40
Three	Electrician	35-49	17
	Rigger	35-49	32
	Commissioning manager	50+	15
	Plant operative	50+	18
	Insulation worker	50+	36
	Electrician	50+	40
	Insulation worker	50+	48
Four	Electrician	25-34	8
	Electrician	25-34	10
	Fabric team leader	25-34	15
	Mechanical services manager	50+	36

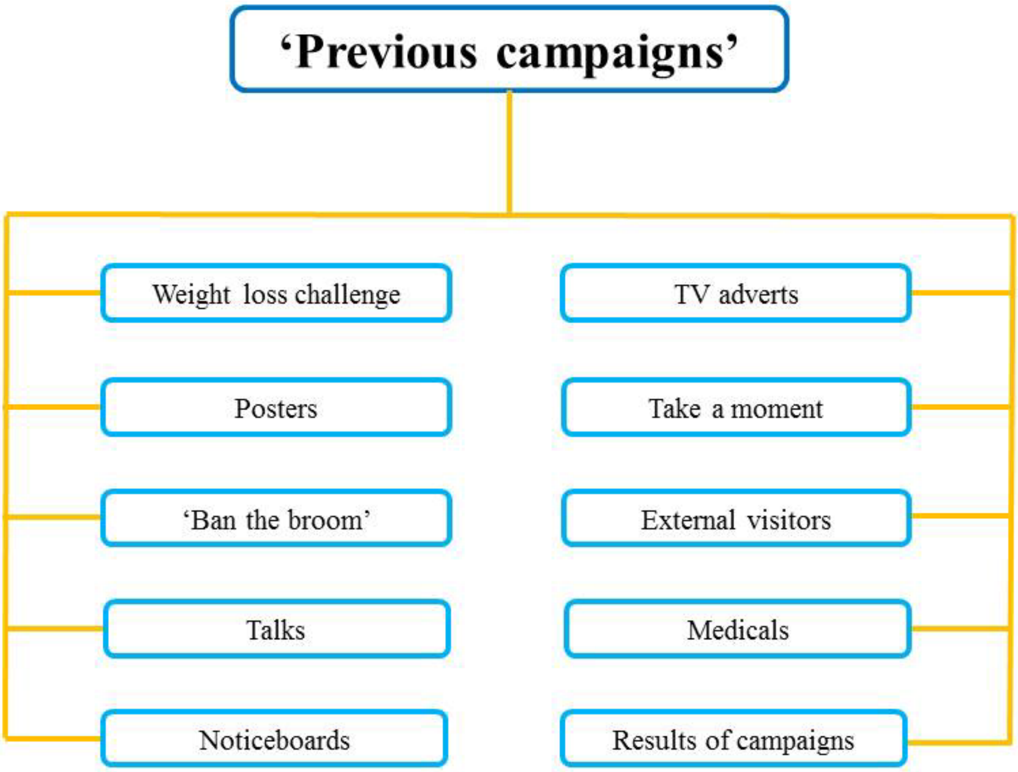
6.7.3 Thematic analysis results

Results from the workshops will be reported in line with the four main themes from the schedule; thematic analysis results from the ‘previous campaigns’ theme will be presented first followed by ‘what’, ‘how’ and ‘who’. Workshop transcripts were analysed using a quasi-statistical and template approach (Miller & Crabtree, 1992).

6.7.3.1 Previous campaigns

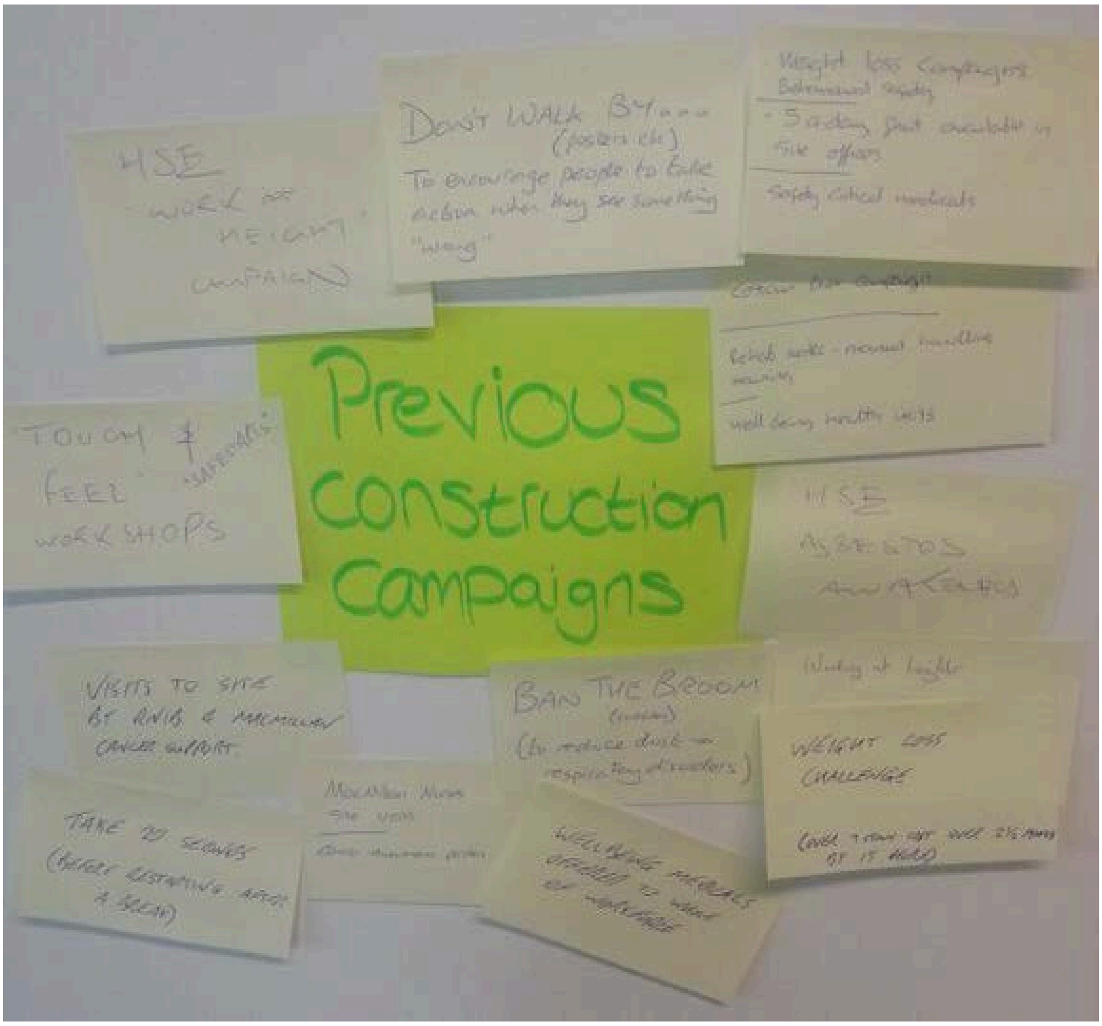
Figure 37 illustrates an example of the thematic analysis undertaken from a first pass read through of the workshop transcripts, a number of sub-themes were developed under the theme of ‘previous campaigns’.

Figure 37: An example of thematic analysis of workshops under the theme ‘previous campaigns’



Participants were asked to write down the names and means of any previous construction campaigns which had been used to encourage health and wellbeing in the workplace or to facilitate change in the industry. To encourage involvement, participants wrote their responses onto post-it notes and stuck them at the front of the room to facilitate further discussion (Figure 38).

Figure 38: Examples of previous construction campaigns from workshops



A total of 22 references were made by senior stakeholders and trades' workers about previous campaigns that have been used to encourage healthy and safe practice on construction sites in the past; 31% (*n=7*) of references were made about poster campaigns. These were considered to be a popular way of advertising changes on work sites as well as encouraging workers to consider their health and wellbeing, such as cancer awareness posters and posters providing information about upcoming events. However trades' workers from the civil engineering company raised an issue with these as they felt that posters were not always updated on the noticeboards situated within their welfare facilities meaning that although posters were being created to advertise changes or events happening around site, they were not reaching the workers regularly, so they were missing out. An example of this was the lack of knowledge about a 'weight loss challenge' happening on their site.

Interestingly, this ‘weight loss challenge’ made up 23% *(n=5)* of the references about previous campaigns. This campaign was held in the civil engineering company; it involved workers being weighed each week and paying £2 to charity if they had gained weight or £1 if they had lost weight or stayed the same. This campaign was in its second season, having been successful the year before, however, some trades’ workers were not aware it had started for the second time, which raised concerns about the communication on this site to encourage involvement from all areas of the workforce.

18% *(n=4)* of the references made were about external visitors coming to work sites and many of these types of campaign were written on the post-it notes in the workshops. Senior stakeholders in the civil engineering company had previously arranged for presentations and talks to be given by various charities such as MacMillan Nurses, British Heart Foundation and the Royal National Institute for the Blind (RNIB) to encourage workers’ awareness and consideration of their health and wellbeing at work. This was considered to be very effective by both senior stakeholders and trades’ workers alike, due to the interesting and novel nature of the campaigns.

14% *(n=3)* of references were made about another, relatively new campaign which was run by the civil engineering company, ‘Ban the Broom’. This was an initiative to increase awareness of dust on work sites and to encourage workers to use vacuums instead of brooms. It was anticipated that this would decrease the risk of respiratory disorders commonly caused in construction by the inhalation of dust and other harmful particles. To enhance this campaign, senior stakeholders such as the project manager had arranged for demonstrations to be given to show the advantages of using machinery such as dust extraction units as opposed to ‘petrol blowers’. There was also discussion around the ‘catchiness’ of the phrase ‘ban the broom’ and consideration of the broom being a ‘ubiquitous tool on site’, having been used for many years. Campaigns such as these demonstrated how small changes can be made to encourage the health and wellbeing of workers, despite the historical nature of some practices in construction.

Other previous construction campaigns that were discussed included ‘Take Five’ which was rolled out across the domestic build company and a similar campaign in the civil engineering company which encouraged workers to take five seconds or ‘a short moment’ before beginning a task to ensure they were acting in the safest way possible (9%, *n=2*). Having medical vans visit construction sites to check the health of the workforce (9%, *n*=2) and television adverts (9%, *n=2*) with celebrity endorsements such as the footballer Stuart Pearce who was formerly an electrician, to increase awareness of safe working, were also noted. All of these campaigns were discussed as ways to reduce hazards and accidents on work sites whilst encouraging the workforce to consider their health and wellbeing at work and taking positive steps to improve this.

6.7.3.2 Capturing ideas for the development of an impact resource

After the discussion about previous campaigns, participants were encouraged to discuss their ideas about ‘what’ type of resource could be used in the industry to encourage engagement of the workforce and increase their awareness of health and wellbeing at work to facilitate longer working lives. They were also asked to brainstorm ‘how’ a resource of this nature could be implemented in the industry and ‘who’ it should be tailored to, to ensure optimum impact throughout the workforce. Table 35 shows a summary of the responses of participants under these themes.

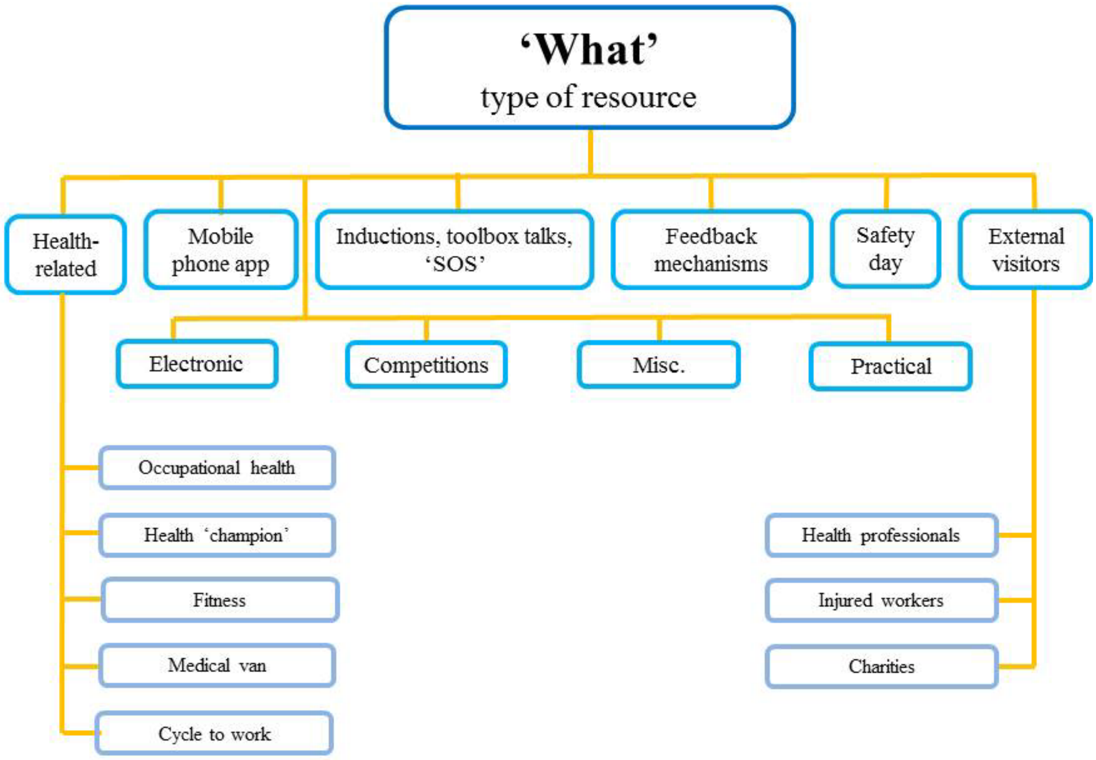
Table 35: Summary of responses about a resource to encourage healthy behaviours in the construction workforce

Theme	Response	% of references *(n)*
'What' type of resource	Mobile phone app	19 *(14)*
	Health-related	19 *(14)*
	Inductions, toolbox talks, start of shift briefings	18 *(13)*
	Inviting external visitors	17 *(12)*
	Feedback mechanisms	7 *(5)*
	Miscellaneous	7 *(5)*
	Competitions	6 *(4)*
	Electronic	3 *(2)*
	Practical	3 *(2)*
	Safety day	2 *(1)*
'How' should it be implemented	Communication	28 *(26)*
	Visually	22 *(21)*
	More emphasis on health	8 *(7)*
	Variety	8 *(7)*
	Practical examples	7 *(6)*
	Making it compulsory	5 *(5)*
	Engaging the workers	4 *(4)*
	Keeping it consistent	4 *(4)*
	Miscellaneous	4 *(4)*
	Providing incentives	3 *(3)*
	Giving workers the choice	3 *(3)*
	Encouraging workers	2 *(2)*
'Who' should the resource be tailored to	Managers and supervisors	27 *(17)*
	Younger workers	21 *(13)*
	Older workers	21 *(13)*
	Capabilities	14 *(9)*
	Everyone	10 *(6)*
	Contractors	5 *(3)*
	Miscellaneous	3 *(2)*

6.7.3.3 'What' type of resource

Figure 39 shows an example of the thematic analysis of the question "'what' type of resource would be most successful?" including 14 sub themes. A total of 72 references were made; the most frequently discussed options were related to a mobile phone app and a resource that should be health-related (19% each).

Figure 39: An example of thematic analysis of workshops under the theme 'what'



Mobile app

There was mixed discussion about the use of a mobile phone app as a resource to encourage engagement with the workforce (19%, *n=14*). Trades' workers and senior stakeholders said that the use of an app could facilitate communication and feedback with the whole workforce by encouraging trades' workers to send in comments or suggestions. Another suggestion was that it could provide 'daily tips' on health and wellbeing at work. Views on this were mixed, with problems about the use of an app including phones not being allowed on site, whether workers 'would be bothered' to use it and older workers not being up-to-date enough with technology. One trades' worker over the age of 50 admitted that he 'did not even know what an app was' let alone know how to, or want to use one.

Despite these concerns, new technology was already in use on sites within the civil engineering company, although not by the trades' workers; engineers and health and safety supervisors were using Ipads to access drawings of buildings and to record notes on site 'walk abouts' when checking for hazards. In contrast to older workers, younger workers were positive about the idea of an app; as they felt it would be a quicker and more convenient way to put forward their ideas, suggestions and general comments however they were keen for these to remain anonymous;

> *"if it was a phone app…I'd sit down at break time and write something, I wouldn't like the idea that it would be my name highlighted anywhere, I would like it anonymous"*
>
> (Trades' worker, domestic build company)

Health-related resource

Many participants felt strongly that a resource introduced to encourage health and wellbeing in construction should have a solid 'health' theme. 19% *(n=14)* of responses under the theme of 'what' type of resource could be successfully implemented referred to this; health-related suggestions included fitness ideas, having a medical van visit sites, having a 'health champion' and cycle to work schemes. Senior stakeholders and trades' workers in the maintenance facility suggested health related ideas such as being given an extra thirty minutes if they attended the gym during their lunch break, being given free gym memberships and advertising walks around nearby areas. One senior stakeholder from the civil engineering company felt that the health initiatives were important to provide workers with a sense of 'personal benefit' rather than just doing it to 'cover someone's backside'.

> *"it's not here, but where my wife works if they do exercise on their dinner break they get an hour and a half…their staff cards, they get logged on so they know they've been to the gym"*
>
> (Trades' worker, maintenance facility)

Visiting medical vans on site were considered to be a good type of resource to improve awareness of health and wellbeing in the workforce. This type of initiative had been proven to be a huge success within the civil engineering company, as one member of the workforce was diagnosed with early stages of cancer and was able to be treated before any 'major damage' was done. Trades' workers in this company felt that this would be a good initiative to continue, providing they were kept well informed about the arrival dates and times of the medical van.

Also within the civil engineering company a 'health champion' had been appointed; a member of the workforce who was responsible for encouraging workers to be proactive about their health at work. Trades' workers in the civil engineering workshop felt that this initiative had been partly successful, with the introduction of pedometers and healthy eating, however sustained engagement with the health champion had been difficult due to a lack of communication. It was suggested that for such an initiative to be built upon as a resource for improved health and wellbeing in the industry, it needs to be adequately advertised to the workforce and communication and engagement must be maintained.

'Cycle to work' schemes were discussed by the workers in the maintenance facility as a resource to encourage workers to be healthier. One worker in the maintenance facility was already actively using this scheme and cycling to and from work as a result. However other workers in the workshop felt that this was not advertised enough as they were not aware of the scheme meaning that the benefits were not widespread.

Inductions, toolbox talks and 'start of shift' briefings

18% *(n=13)* of references about 'what type of resource' would be successful were made about building upon existing site inductions, toolbox talks and start of shift briefings to encourage engagement with the workforce. Site inductions are compulsory for every individual working on a construction site and are well known for being intensely based around the 'safety' element of health and safety at work. Senior stakeholders made suggestions for a resource to be introduced to improve these, such as facilitators for discussion about what workers would like from the company during their time working on site, a multiple choice quiz at the end of the induction, leaving the room and walking around the site with workers to 'wake them up a bit' and showing videos to introduce more variety to inductions. A resource facilitating interactive toolbox talks was suggested by the Director of the domestic build company as a way of engaging with workers and encouraging discussion about health and wellbeing. Suggestions were made such as doing 'face fit testing' with workers to demonstrate the variety of dust masks available or providing samples of gloves for workers to try on and discuss. A project manager in the civil engineering company also identified that a resource could be built upon their existing 'start of shift' briefings with workers, where supervisors inform the workforce of salient events happening on site that day.

Visits from external charities, health professionals and injured workers

17% *(n=12)* references about 'what type of resource' would be successful in the industry were made about the use of external visitors. They were considered to be a good way of encouraging engagement and improving awareness of health and wellbeing in the workforce. Visitors such as occupational health nurses, health professionals, previously injured construction workers, and presentations from charities were suggested by senior stakeholders and trades' workers alike. It was acknowledged by both parties that having someone from a different profession visit the site and talk about health problems may have more of an impact than listening to a construction supervisor, due to a higher perceived level of credibility. Senior stakeholders also acknowledged the benefits of having a 'new face' on site to capture the attention of the workforce and trades' workers identified the advantages of inviting health professionals who can explore issues relating to health and wellbeing in more depth than construction supervisors;

> *"it hits home more, when it comes from people who have come from that field, you know saying 'I see people dying every week from cancer 'cos of this', it has the impact I think"*

(Trades' worker, civil engineering company)

Alternative suggestions for external visitors were to have talks from previously injured construction workers, however there were mixed opinions regarding their impact. The manager of the maintenance facility acknowledged the 'remarkable impact' made by a previous visit from an injured worker, however was concerned about the 'dilution' of this impact twelve months down the line, when workers may remember the talks, but may not have changed their own behaviours. Similarly, a trades' worker in the maintenance facility agreed that hearing the stories of injured workers are 'very touching' but admitted to having an attitude of 'it will never happen to me though'.

One senior stakeholder in the civil engineering company suggested inviting charities to give talks to the workforce on health and wellbeing. This had previously been successful on their site, with the 'Royal National Institute of Blind being more than happy to come out' and providing 'various glasses, which replicate eye injuries' to facilitate interaction and engagement with workers about safe working and the use of PPE. These visits from external charities were thought to have similar benefits to those of visiting health professionals in terms of novelty and perceived credibility.

Feedback mechanisms

7% *(n=5)* references were made suggesting a resource which enabled better feedback between the workforce and senior stakeholders. One trades' worker in the civil engineering company felt that this was important as workers currently feel that their ideas are not being listened to which is discouraging workers to put forward their suggestions and ideas. Similarly, trades' workers in the domestic build company suggested that a resource such as 'a black book' could be introduced so workers could write down their suggestions and they could be 'addressed properly', although the trades' workers did not specify how they would like this to be done. Additional ideas for a resource to facilitate better feedback were 'suggestion cards' that could be put into boxes around site. However this was disputed by a trades' worker as they considered that trades' workers would not have time to fill them out due to being 'pushed by the site managers' to finish their jobs on time.

Other suggestions

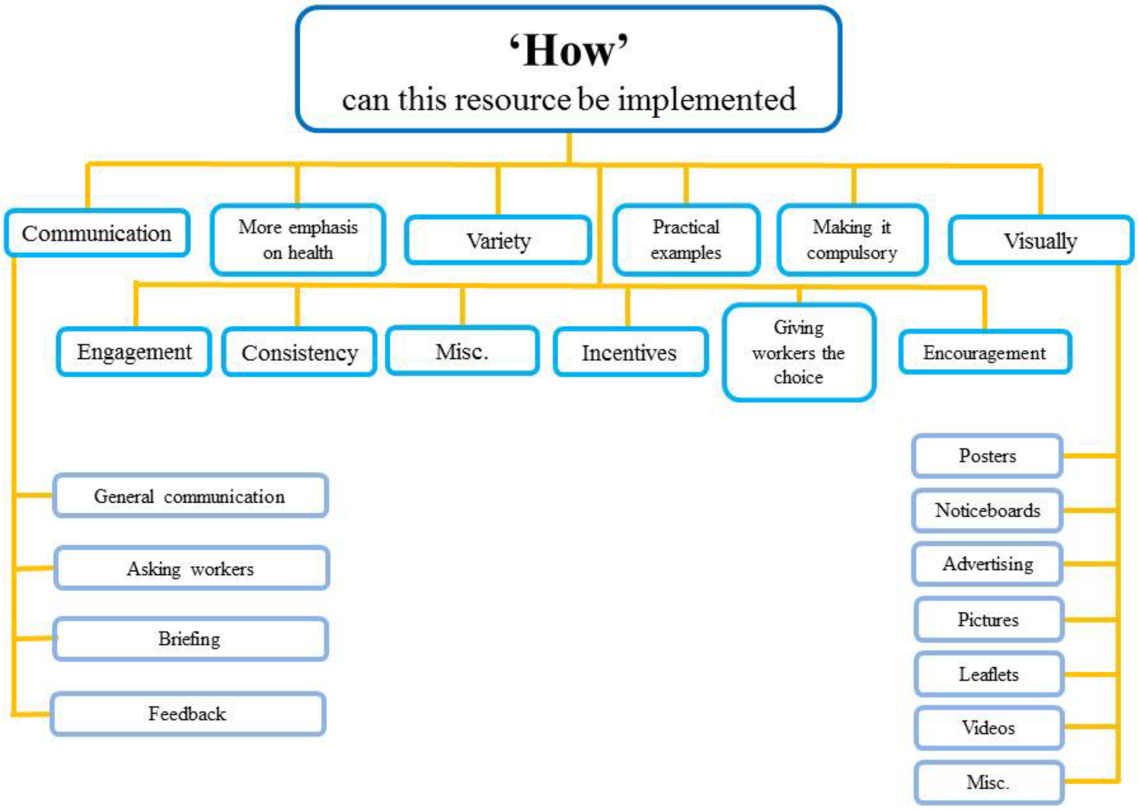
Further ideas for resources to encourage engagement of the workforce included incentives such as competitions (6%, *n=4*). A 'star of the month' was suggested by trades' workers in the civil engineering company, where workers are given the opportunity to vote for a colleague with a brief reason, although a prize for this was not discussed. Trades' workers in the maintenance facility (3%, *n=2*) pointed out that a resource such as a leaflet was unlikely to be looked at in comparison to an electronic resource, however they were unsure of what type of electronic resource would be successful. Two participants (one senior stakeholder and one trades' worker) also noted that the resource should encourage more practical measures to be taken to encourage engagement of the workforce although examples were not provided. One senior stakeholder in the civil engineering company advocated a 'safety stand down day' as a resource which would encourage workers to discuss health and safety under various themes for the day such as 'health and wellbeing'. References were also made by two senior stakeholders that using only one type of resource would not be sufficient to maintain the attention of the workforce and that a variety of techniques would be more effective when trying to engage them in considering their health and wellbeing at work. It was acknowledged that 'a mixture of things' should be used, whilst simultaneously ensuring that the information given was specific as well as providing information about where to go for further details should they be required.

Overall, much of the discussion around 'what' the resource should be was related to interaction of the workforce. All suggestions were concerned with capturing and maintaining the attention of the workers by using a mixture of novel and interesting techniques to facilitate discussion about health and wellbeing at work.

6.7.3.4 'How' the resource can be implemented

Participants were asked 'how' a resource to increased awareness of health and wellbeing and facilitate engagement and communication with the workforce could be implemented to have the most impact. A total of 92 references were made; figure 40 illustrates the thematic analysis including 12 sub-themes.

Figure 40: An example of thematic analysis of workshops under the theme 'how'



Communication

The most frequent references (28%, *n=26*) were about communication and within this, four sub-themes were created; ‘general communication’, ‘asking workers’, ‘briefing’ and ‘feedback’.

‘General communication’ included suggestions from trades’ workers in the civil engineering company such as having regular and frequent discussions with the workforce and supervisors. They felt that previous initiatives and events had gone unnoticed by the workforce due to a lack of communication from supervisors; therefore to ensure the success of a resource in the industry, it must be communicated effectively. One senior stakeholder suggested that a resource could be implemented by arranging sessions to employ a ‘you said, we did’ policy, to encourage workers to communicate their ideas to their supervisors and to build a level of trust and understanding between workers and senior managers. Several other trades’ workers advocated ‘more discussions’ as a way to implement resources effectively throughout the workforce. Trades’ workers in the civil engineering company felt that it was important that the whole workforce receive the same information in a timely manner, whether verbally from their supervisors or through regularly updated posters on their welfare noticeboards.

‘Asking workers’ was another suggestion for implementing a resource from senior stakeholders and trades’ workers alike. Trades’ workers from the civil engineering company indicated that they appreciated being asked if they wanted certain events to be arranged, such as a visit from a medical van or talks from charities. Similarly a senior stakeholder claimed that ‘text-heavy is a no-no’ when implementing resources and instead advocated asking questions of the workforce, to ascertain what benefits they would like to see from initiatives. Workshops were suggested to facilitate discussion around what workers would like to see and to encourage them to be more ‘open and honest’.

There was a lot of discussion around ‘briefings’ from trades’ workers in the civil engineering company. As previously discussed, ‘start of shift briefings’ were already in place in this company and workers felt that these could be improved to encourage communication and implement new resources. However there were mixed reviews about this; one trades’ worker felt that it would be a good idea to include information during briefings about upcoming interventions and events however another trades' worker felt that because the briefings were everyday they had become mundane and no workers paid attention to them, rendering them a poor tool to implement new resources.

'Feedback' was considered to be very important by trades' workers in the domestic build company, particularly when workers make suggestions for changes to their jobs or workplaces. Trades' workers highlighted the importance of their supervisors acknowledging their suggestions or ideas for change and providing feedback on them to indicate that some form of action has been taken;

> *"maybe once a month or something they bring up all the cards…and then you know, if your one is in there and nothings' been said about it, you know no-one's taken any notice"*
>
> (Trades' worker, domestic build company)

Visually

The second most common reference (22%, *n=21*) made about how a resource could be implemented, was to make it as visual as possible. Ways of doing this included the use of posters, noticeboards, pictures and videos. 'Hard hitting' statistics were suggested as content for posters to encourage workers to consider their health at work such as 'how many people have been injured on roofs' or 'did you know on construction sites this year there have been this many injuries', although interestingly, these two suggestions made by a trades' worker were related to 'safety' rather than health. Using posters to frequently advertise interventions and campaigns was also suggested, to ensure workers' awareness of the resources available to them. Trades' workers in the civil engineering company also that it was important for posters to be regularly updated, as if they were not, noticeboards quickly become mundane and unnoticed. The use of leaflets was strongly discouraged by trades' workers in the maintenance facility, they said that this type of propaganda would be thrown away without being looked at due to the amount of leaflets around their workplace.

More emphasis on health

8% *(n=7)* of references were made about creating more of an emphasis on health to ensure a resource could be implemented successfully. Trades' workers in the civil engineering company felt that the industry was saturated with safety information; they noted that there is often a bias on safety when health and safety posters are put up on noticeboards. Trades' workers in the domestic build company acknowledged that if workers felt they were being more healthy they would be more likely to 'buy-in' to new initiatives, such as cheaper, healthier options for breakfast on site. A trades' worker in the maintenance facility also identified the importance of an emphasis on health, such as the 'cycle to work' schemes which would be more successful if they were communicated to workers with the information about how they could improve their health and wellbeing.

Variety

Senior stakeholders and one trades' worker made references about the importance of variety when implementing a resource (8%, *n=7*). The trades' worker from the civil engineering company said that they did not think posters were 'the only answer' and a senior stakeholder acknowledged the importance of information coming from different sources, such as external visitors. In addition to a variety of mediums, one senior stakeholder also suggested that initiatives should not be used 'every single day' in order to maintain impact. Further suggestions were to use a 'variety of techniques such as posters and videos' and to use a 'mixture of examples such as real life feedback'. Despite the identified importance of variety, senior stakeholders also acknowledged the significance of setting a 'standard way of doing things' and sustaining campaigns to avoid them 'dropping off'.

Practical examples

7% *(n=6)* of references suggested that the impact of a resource could be increased with the use of interactive, practical examples. These included suggestions from senior stakeholders such as asking workers to wrap elastic bands around their fingers to simulate the symptoms of vibration white finger or wearing goggles to simulate eye injuries or blindness. Trades' workers also suggested practical demonstrations such as dropping bricks on watermelons to simulate the damage that could be done when not wearing a hard hat and throwing dummies from roofs to simulate the risks of working at height. All participants felt that the use of practical examples could increase the engagement of the workforce.

Other suggestions

Additional suggestions regarding how to implement a resource in the industry were to make it compulsory (5%, *n=5*). Senior stakeholders identified that there is already ‘contractual pressure’ present, which requires sub-contractors to fill in health and safety-related questionnaires; they suggested that health and wellbeing initiatives could also be introduced as contractual requirements. Similarly, trades’ workers in the maintenance facility said that if health–related courses were made compulsory it may increase workers’ awareness of their health and wellbeing at work. A senior stakeholder also felt that engagement must ‘come from the top’;

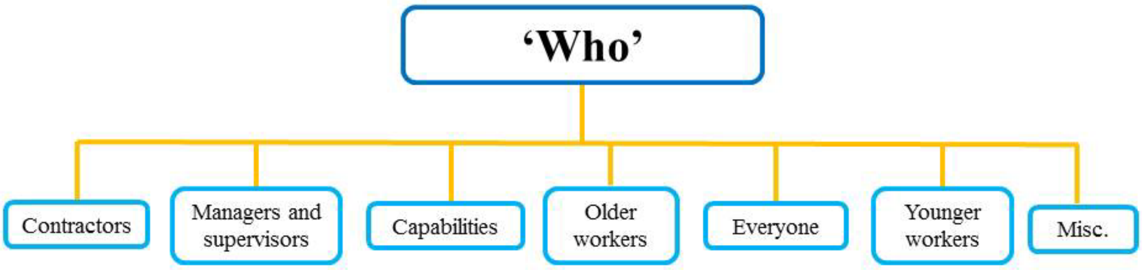
> *“a managing director or chairman who insists health and safety comes first every time”*
>
> (Senior stakeholder, maintenance facility)

Senior stakeholders acknowledged that to implement a resource encouraging awareness of health and wellbeing at work, it needs to be made more personal and engaging (4%, *n=4*). They acknowledged that playing videos and using slideshows are not conducive to engaging with their workforce or holding their attention and that these methods should be used to facilitate discussion between the workforce and supervisors. Additional ideas about how to implement a resource were to keep it simple, provide incentives to ensure worker participation, to give workers the choice of involvement to avoid an ‘I say, you do’ culture and to encourage workers’ participation and acknowledge and praise their good working practices.

6.7.3.5 ‘Who’ the resource should be tailored to

Participants were also asked if there were any particular workers in the industry who would particularly benefit from interacting with a resource to encourage awareness of health and wellbeing to facilitate longer working lives. A total of 61 references were made under this theme; figure 41 illustrates the thematic analysis.

Figure 41: An example of thematic analysis of workshops under the theme of 'who'



Managers and supervisors

Several references were made about managers and supervisors 27%, *n=17*) in relation to the development of an impact resource to encourage awareness of health and wellbeing in the industry. Senior stakeholders felt that they were very important for 'buy-in' and that if managers and supervisors were 'behind' an initiative, it could considerably increase the likelihood of involvement and engagement of the workforce. Supervisors (or 'blue hats') were considered to be vital lines of communication between senior members of staff and workers due to daily briefings with the workforce. It was also felt by stakeholders and trades' workers alike that members of the workforce lacked the control, power and influence to effect change whereas supervisors were considered to be 'in charge' and more able to assert authority. They were considered to be important as they were the first point of contact for the trades' workers, so guidance and advice on how to encourage engagement of the workforce, idea generation and awareness of health and wellbeing would be most beneficial to them.

Despite managers and supervisors being considered to be important, senior stakeholders identified an issue with younger supervisors in particular. Senior stakeholders felt that they often had very little managerial training and had commonly 'worked their way up' to a supervisory role; this was considered to have potentially negative effects, such as young supervisors struggling to be authoritative with their friends on site. Despite this, younger trades' workers (aged 25-34) in the domestic build organisation felt that supervisors (or foremen) were generally able to assert authority and were good at ensuring healthy safe practice is followed on site;

“supervisors generally come up through the ranks and they’re mates for all the workers and that’s a crucial step in between being a worker and being a supervisor that you do have to step away and those friendships that you’ve got, they almost have to be broken to a certain point”

(Senior stakeholder, civil engineering company)

Younger and older workers

There were an equal number of references suggesting that a resource should be developed towards younger or older workers (21% each, *n=13*). One trades’ worker from the civil engineering organisation felt that it was important to steer guidance about working behaviours and wellbeing at work towards younger workers, particularly apprentices, as they would be new in the industry and ‘would not know any different’ therefore engraining healthy working practices and an awareness of health and wellbeing at work from the beginning of their careers. It was felt that by doing this, younger workers would be more aware of how they will age in their trades and take more care of themselves whilst at work. A common viewpoint from several participants was that early education of younger workers may result in fewer incidences such as injuries and ill health as they age. A senior stakeholder identified that many of their older workers on site ‘tend to moan about the young 20 year old lads’ as they are considered to be lazy and an older trades’ worker in the domestic build company also claimed that you ‘can’t even get them off their iPhone’. For these reasons, younger workers were considered to be an important audience for a resource focusing on engaging of the workforce.

In contrast, older workers were also identified as an important group to work with by trades’ workers and senior stakeholders alike due to progressive changes in working practices in the industry such as an increase in regulations for personal protective equipment;

“it’s us who needs educating, the older ones, quite often it’s like wearing a seatbelt, when I learnt to drive you didn't have to wear one but people learning now have to wear seatbelts”

(Trades’ worker aged 50+, civil engineering company)

The Director of the domestic build company identified that older workers on their sites were having more injuries, making them an important group to work with to reduce risk. Similarly it was acknowledged by other senior stakeholders that older workers may be more open to health and wellbeing initiatives due to being more concerned about this in later life and their changing attitudes over time, such as becoming more accepting of new rules and regulations. Older workers were also considered to be important mentors for younger members of the workforce, passing on their knowledge and experience but also simultaneously passing down their bad habits. For this reason, participants suggested that a resource developed to improve health and wellbeing should be tailored towards older workers to facilitate better knowledge transfer.

Trades' workers in the maintenance facility also identified the changes in attitude of workers who have families; they said that construction workers were more likely to take care of themselves and be concerned about healthy and safe working practices if they had young children and a family to provide for;

> *"I think the time to change is between the ages of 20 and 30, that's when my attitude changed…I've got responsibilities now"*
>
> (Trades' worker, maintenance facility)

Capabilities

The capabilities of the workforce were also considered when suggesting ideas for the development of a resource (14%, *n=9*). Trades' workers from the domestic build company and the maintenance facility felt that no matter whom the resource was created for, it should be developed at the right level to ensure workers' interest and understanding. One trades' worker from the domestic build company said that 'you have to be careful because some workers are absolute idiots' whereas trades' workers from the maintenance facility acknowledged that 'construction people aren't academics'. Based on these perceptions, trades' workers suggested that a resource needs to be developed for people who are more 'practically-minded' and who do not necessarily respond well to text-heavy resources. These suggestions reinforce the idea that a resource should be visual and engaging.

Everyone

10% *(n=6)* references were made by senior stakeholders and trades' workers agreeing that a resource should be created for 'everyone' in order to improve communication and awareness of health and wellbeing across the entire workforce. It was acknowledged that regardless of the type of resource developed or how it could be implemented, not everyone will always want to be engaged, and therefore a resource created for the entire workforce would be most likely to encourage participation from the most workers. There were also discussions about the personality of the workers and this was unrelated to age or trade such as workers 'not wanting to be told what to do'; participants suggested that this could affect the overall attitude of the workforce and could mean that sometimes interventions will be unsuccessful.

Contractors

One trades' worker from the civil engineering company and two senior stakeholders (civil engineering company and domestic build company) made references about contractors being the most appropriate audience for a resource (5%, *n=3*). One senior stakeholder admitted that through multiple inductions they have noticed that the least engaged workers are the sub-contractor managers, which makes engaging the sub-contracted workers very difficult. Another senior stakeholder agreed and identified the issue of having a sub-contracted workforce, which can make it difficult to tailor a resource to a specific audience when they are not directly employed; they claimed that 'if their managers aren't engaged then the guys themselves aren't going to be engaged'. These participants felt that getting contractors on board was essential, as similar to the managers, they are in charge of a large proportion of the workers on their sites, suggesting that a resource could have more impact if it was tailored to them.

Other

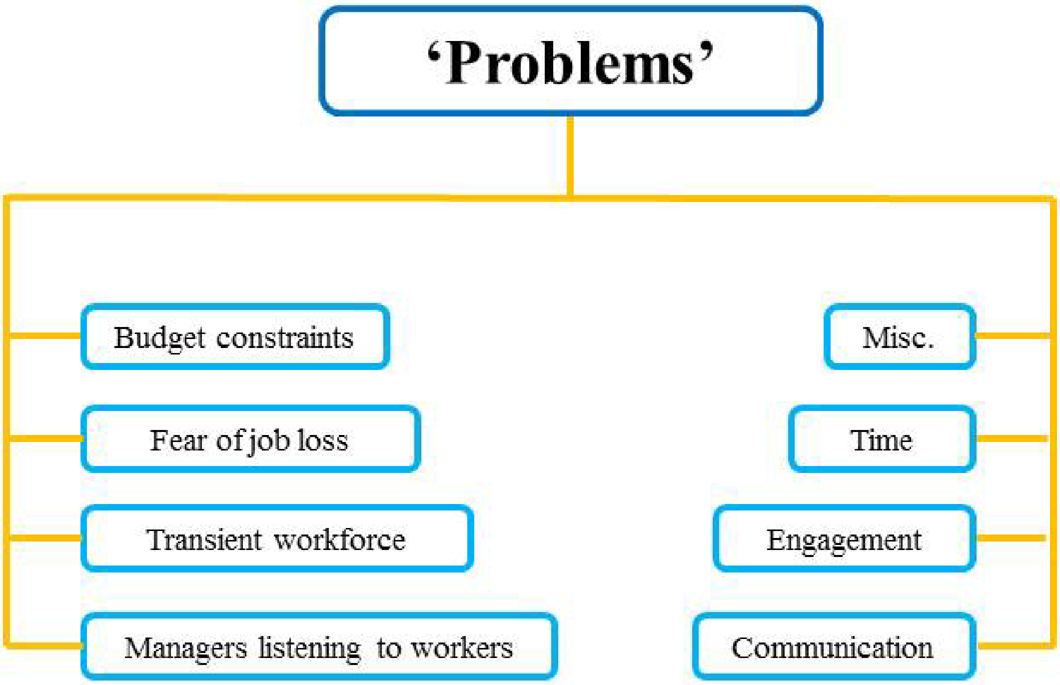
Additional ideas for 'who' a resource could be created for included consideration of the 'line of work' individuals are in; those on price work may be less inclined to take time out to consider new initiatives as this may cause them to lose money. One trades' worker from the civil engineering company warned about 'dictating to workers' and felt very strongly that they should be given the choice to participate in health and wellbeing initiatives;

> *"you've got to be careful how far you go with that because now you're starting to dictate…what you've got to watch is targeting, you've already singled people out, you should be putting the information up and if the blokes want it they'll come and get it, if they don't they won't come and get it! I don't think we should target people"*
>
> (Trades' worker aged 50+, civil engineering company)

6.7.3.6 Problems

When discussing the development of a resource, senior stakeholders and trades' workers in all four workshops raised a number of concerns about it being implemented; figure 42 illustrates the thematic analysis. A total of 57 references were made, the most commonly discussed problems were related to workers fearing job loss if they spoke up, budget constraints and managers listening to workers (18% each).

Figure 42: Problems with creating a resource



Fear of job loss

18% *(n=10)* references were made about workers fearing job loss, causing a problem for the implementation of a new resource to encourage idea generation and engagement of the workforce. Trades' workers in the domestic build company felt that if they suggested ideas for change to their supervisors, they would be risking their jobs; they felt that managers would not respond well to workers wanting change and in response, they would find other people to do the work. A similar concern was voiced by trades' workers in the maintenance facility; it was acknowledged that a worker would be within their rights to refuse to do a task if they felt it breached health and safety regulations however if they were to do so, it could lead to potential job loss if they upset their boss. All trades' workers agreed that there was a prevailing attitude of 'if you won't do it, someone else will' throughout the industry. Job loss was also a concern for trades' workers in the civil engineering company particularly for initiatives such as visiting medical vans to site. Whilst the advantages of these were acknowledged, trades' workers felt that if health professionals were to 'find something wrong with you' it could potentially lead to being deemed unsafe or unfit for work and therefore job loss.

Budget constraints

Trades' workers in the maintenance facility and domestic build company made 10 references to budget constraints (18%); interestingly, no senior stakeholders identified money as a barrier to the development or implementation of a new resource. Trades' workers from the domestic build company said that if they suggested changes to their managers and supervisors, the first response would be that 'it would cost too much'. They also stated that they felt under a lot of pressure to make money and therefore did not have the time to make suggestions for changes; for these reasons trades' workers were concerned that a resource introduced to the industry to encourage healthy working practices would not be sustainable or successful due to a lack of interest from workers. Conversely, trades' workers in the maintenance facility discussed how the expected budget constraints on an industrial building site were not present within their facility due to them having a permanent, salary paid workforce;

> *"if you think about the industry outside and people who are self-employed…they haven't got time to do it, whereas in this organisation, everything's paid for…we don't lose any money, we don't lose any time, so a lot of it is down to the organisation you're working for"*

(Trades' worker, maintenance facility)

Managers listening to workers

18% *(n=10)* references were about managers not listening to the workforce. One trades' worker from the civil engineering company said that whilst managers may appear to listen, suggestions are never developed or actioned and trades' workers in the domestic build company felt that their managers did not forward their suggestions on to senior members of staff. They felt that as trades' workers, they had 'no voice' and that no-one cared about their opinion. These concerns contributed to the perception from workers that developing a resource to encourage engagement and idea generation within the construction workforce would be futile, as it is notoriously difficult to effect change in the workplace.

> *"the construction gang is the lowest of the low, because you ain't got a voice"*

(Trades' worker, domestic build company)

Communication, engagement and time taken for changes to be made

Additional problems identified regarding the development of a resource for the construction industry included communication between workers and managers (12% *n=7*), engagement of the workforce (12%, *n=7*) and the time taken for changes to be made (12%, *n=7*).

Trades' workers in the civil engineering company felt very strongly that senior members of the workforce did not spend enough time talking to their workers about upcoming events. During the workshop, a number of health and wellbeing initiatives arranged by the company were discussed, such as 'the weight loss challenge' and visiting medical vans, however it quickly became apparent that several trades' workers were unaware that these were happening across the site, as discussed earlier. These previous poor communications led to the perception from trades' workers that the development of a resource would be pointless as it would be not communicated adequately through the workforce.

Trades' workers in the civil engineering company and maintenance facility agreed that the development of a resource would be hindered by the lack of engagement with the workforce. They felt that workers would only be interested in health and wellbeing initiatives if they perceived a direct benefit to themselves;

> *"I only think I'd ever do something, look at something, if it has hurt me before…just because he's got a bad back doesn't mean I'm interested in it"*
>
> (Trades' worker, maintenance facility)

One senior stakeholder also acknowledged the difficulty in engaging workers, claiming that 'people switch off quickly' which can affect the success of interventions.

Workers in the civil engineering company had concerns about the introduction of a resource to improve and encourage awareness of health and wellbeing on site due to previous delays in making changes such as fixing hot water on site, or having cleaners employed for the welfare facilities; elements that trades' workers considered to be essential for their health and wellbeing at work. Conversely trades' workers from the domestic build company and senior stakeholders identified the time it may take to implement such resources and considered this to be a barrier. Senior stakeholders highlighted the concern contractors may have regarding loss of productivity when implementing such a resource which encourages workers to discuss their health and wellbeing at work; as they may not view this as an efficient use of trades' workers' time. Similarly, trades' workers said that if a 'better' way of doing your job (to improve health and wellbeing at work) is going to slow you down, 'it's almost like you can't do that' as this would result in a loss of money for those on price work.

Other

Additional problems included concerns from the trades' workers in the domestic build company about a transient workforce creating a lack of longevity in interventions suggested by the workers themselves and a lack of consistency regarding rules on sites;

> *"We're on site for a maximum of six months and then it's onto the next; you're a new face, then you're gone, then you're a new face"*
>
> (Trades' worker, domestic build company)

Senior stakeholders felt that developing a resource which should be tailored to supervisors should really ensure that they lead by example, as they felt this was not currently the case. They felt that there were already issues such as supervisors enforcing the rule of 'no mobile phones on site' and then being seen on their mobile phones themselves throughout the day, suggesting that supervisors need to take more responsibility before resources can be introduced.

Senior stakeholders were also concerned about buy-in from more senior managers if they were asked to invest more time and money into the development of a new resource to encourage awareness of health and wellbeing and engagement of the workforce;

> *"at the very top as well the guys can ask the same questions as the guys at the bottom 'what's in it for me?'…to my boss…at the moment he doesn't see the benefit of that"*
>
> (Senior stakeholder, domestic build company)

6.7.3.7 Concerns about an ageing workforce

From the end of session questionnaire, 13 participants answered the question "are you concerned about an ageing workforce?" (five senior stakeholders and eight trades' workers). 85% *(n=11)* responded that they were concerned about an ageing workforce in construction; all senior stakeholders and six trades' workers. There was a worry that the skills, experience and knowledge of older workers would be lost, particularly because there are less young workers being attracted to the industry meaning that the knowledge and skills cannot be passed on and that the impact of construction work can have a negative effect on older workers' health and wellbeing. There were also concerns about older workers' abilities to carry out intensive manual tasks, having more health problems and 'not being able to do the job that is expected of them'. 15% *(n=2)* of these responses claimed there were no concerns about an ageing workforce; one trades' worker simply stated "no" and another said they were not concerned because they were going to retire aged 55.

Speaking to the Government and Members of Parliament about an ageing construction workforce

10 participants responded to the question "if you could speak to the Government and Members of Parliament (MPs) about older workers in construction, what would you say to them?" four stakeholders and six trades' workers. This question was posed to encourage participants to think about the worries and concerns they have about older workers in the industry. 30% *(n=3)* of these responses were about healthcare in the construction industry and came from two trades' workers and one senior stakeholder. They were interested in whether all construction workers could get free health checks and 'more health care'. Another 30% *(n=3)* of responses were from two trades' workers and a senior stakeholder about the retirement age of construction workers; the senior stakeholder suggested that it needed to be reduced for older workers and younger workers needed to be encouraged through apprenticeships whilst one trades' worker stated that increasing the retirement age is 'all well and good for an office worker but construction is a lot harder'. Additional responses included wanting to ask MPs how they proposed to deal with the ageing workforce and how older workers could be retained in the industry to transfer their skills when they are less able to carry out heavy manual tasks.

6.8 Discussion

Four workshops were facilitated with senior stakeholders and trades' workers in three construction organisations to capture their ideas for the development of a resource to engage and interact with the workforce to increase awareness of health and wellbeing at work to facilitate longer working lives. In this section, the most prominent and important findings in relation to the objectives will be discussed in relation to previous research studies in this area, followed by the limitations of this study and the conclusions.

The most prevalent and important finding from this study was that in order for a resource to successfully encourage construction workers to engage in health and wellbeing initiatives and facilitate idea generation, it must be as visual and interactive as possible. This was an important element when considering both ‘what’ type of resource would be successful and also ‘how’ it could be implemented, with both trades’ workers and senior stakeholders suggesting that practical examples could facilitate interaction with the workforce. This suggestion is supported by the Health and Safety Executive (HSE), who in 2001 announced that health and safety education should be presented ‘as an intellectual challenge illustrated by practical example’ (HSE, 2001). Goedert et al., (2011) also claimed that training methods in construction need to be reinvigorated as they ‘have changed little in over a century’. Techniques of interactive learning with the inclusion of ‘hands-on’ tasks and practical tests have been shown to be very successful in previous research (Abdulwahed & Nagy, 2009; White, 2010; Goedert et al., 2011; Pasin & Giroux, 2011) and have been shown to increase peoples’ ability to transfer new knowledge from their short term memory into their long term memory (Cairncross & Mannion, 2007). This provides strong evidence for using these techniques in the development of a resource to encourage workers to consider their health and wellbeing at work, facilitating longer, healthier working lives.

Further suggestions for visual resources to encourage awareness of health and wellbeing at work from both trades’ workers and senior stakeholders included videos for health and safety inductions, posters with ‘hard hitting’ visual statistics, practical learning opportunities during toolbox talks such as injury and ill health simulations and also the potential introduction of a mobile phone app to encourage engagement and feedback. The use of interactive videos in training sessions has been shown to be historically successful in a variety of industries such as training bus drivers to deal with difficult passengers (Rushby, 1987), simulated interviews for trainee recruitment managers (Rushby & Schofield, 1988) and more recently fire officer training (Powell et al., 2008). Despite the wide range of research in other industries, there has been very little research into the effects of interactive learning techniques in construction; Gherardi & Nicolini (2002) summarise that construction workers are often ‘taught’ in a classroom setting with very little interactive, practical knowledge gain and are then expected to go out on site and use this knowledge in a practical setting. Cherrett et al., (2009) found positive outcomes when using interactive videos during lectures with civil and environmental engineering students. The students were required to click on potential hazards shown on a screen to enhance their knowledge of health and safety risks on site; 64% of the students agreed that a mixture of the lecture and the video was the most effective delivery mechanism, claiming that the interactive nature of the video held their attention. However as this study used students, the results cannot be generalised to construction trades' workers, particularly due to the different means through which they enter the industry. Nevertheless, these studies do suggest that providing relevant and appropriate information in an interactive format to construction workers could increase their awareness and understanding of their health and wellbeing at work and encourage them to consider how they will age in their trades.

There were mixed views from senior stakeholders and trades' workers regarding a resource being introduced in the form of a mobile phone app to encourage feedback, communication and consideration of health and wellbeing in the construction workforce. Site restrictions regarding the use of mobile phones were identified in addition to concerns about older workers not being 'tech-savvy' enough to make use mobile technology. However younger trades' workers admitted that they would use it in their break times if they could anonymously make suggestions and comments to improve their jobs and workplaces. There has been previous research into the use of a mobile app which was trialled with employees in a large construction company who could message an online portal with suggestions and ideas (Davies & Harty, 2014). However there were mixed findings during the trial; only 17% of employees installed and registered themselves on the app and a total of 219 ideas were submitted in the first ten months of operation. These findings support the suggestions from the senior stakeholders and trades' workers that a mobile app may not be the best type of resource to use to encourage widespread engagement of the construction workforce.

The use of simulation equipment and materials to encourage engagement, interaction and empathic learning about health and wellbeing has been well researched by Gibb et al., (2015); these include the development of 'LUSKInS' gloves, which simulate the symptoms of the skin disorder dermatitis, an osteoarthritis simulation and the 'third age suit' which was initially developed to raise awareness of the needs of older drivers and then went on to simulate ageing in construction workers (Cook et al., 2009). Senior stakeholders and trades' workers in the workshops suggested similar techniques to simulate construction related health problems, such as wearing damaged goggles to simulate eye injuries, which has previously been used in research to simulate age related declines in visual ability (Ishihara et al., 2001), using elastic bands wrapped around fingers to simulate the symptoms of vibration white finger and more simple ideas such as dropping bricks onto watermelons from heights to simulation the dangers of not wearing head protection on building sites. The positive findings of previous research studies investigating these types of techniques suggests that interacting with the workforce in this way can encourage workers to seriously consider their health and wellbeing at work. This was further supported when one trades' worker claimed that he would not be interested in learning about health problems he was not currently suffering with himself, highlighting the importance of the use of simulations to encourage empathic learning.

In addition to participants identifying the importance of interaction with the workforce when using a resource, communication, discussion and feedback were also considered to be essential by both trades' workers and senior stakeholders. This is supported by previous research; Kaskutas et al., (2013) found that better levels of communication regarding safety behaviours in construction has led to a decrease in the risk of injury and Dainty et al., (2007) claimed that 'the importance of effective communication to individuals, teams and organisations cannot be overstated' and that in order for construction organisations to understand the needs of their workforce, a two-way channel of communication is absolutely essential. In 1999, Wogalter et al., proposed a 'Communication-Human Information Processing' model which describes how during communication, the receiver of the information goes through different stages. They believed that for an individual to change their behaviour, the information being communicated must appeal to their attention, comprehension, attitudes and belief and their motivation. This model highlights the importance of adequate and appropriate communication when attempting to encourage workers to adopt healthy working practices in construction (Wogalter et al., 1999). Koolhaas et al., (2015) identified the importance of getting insight into the 'obstructive and facilitative factors' of ageing at work from the workers' own perspectives as they are capable of solving work-related problems.

To develop a resource to encourage idea generation from the workforce, trades' workers felt that feedback on any ideas and suggestions put forward was essential.

They identified the current lack of feedback as a significant barrier to idea generation in the industry as workers do not feel they are listened to by their supervisors when they make suggestions. Previous research has shown that processes such as 'solution sessions' and idea books or boards which involve workers identifying health risks and subsequently generating and co-developing ideas to resolve these with supervisors and managers can lead to the development of sustainable and practical solutions, which in turn can decrease the risk of ill health and injury at work (Vink et al., 1997; de Jong & Vink, 2002; Loch et al., 2010). Participants in all workshops discussed a variety of feedback channels, such as the use of welfare noticeboards and posters, 'start of shift' briefings, toolbox talks and simply holding discussions between workers and supervisors to encourage idea generation and suggestions to improve health and wellbeing in their jobs and workplaces.

Both trades' workers and senior stakeholders suggested building upon existing toolbox talks to develop a resource to encourage awareness of health, wellbeing and idea generation in construction. It was felt that these could be enhanced and improved by encouraging more communication and discussion although previous research has suggested that toolbox talks have a bad reputation in construction, for being 'boring' or a 'waste of time' (Kaskutas et al., 2013). Despite this, Choudry & Fang (2008) claim that they are one of the most effective factors for site safety. Senior stakeholders felt that the frequent and compulsory nature of toolbox talks created an open forum to encourage better lines of communication between the workforce and senior management which in turn could facilitate idea generation and discussion about healthy working behaviours. These suggestions support findings from Nyateka et al., (2012) who claim that training is a fundamental requirement for preventing occupational illnesses and improving the industry's occupational health performance.

The importance of supervisors was identified when discussing 'who' an impact resource should be tailored towards; their 'buy-in' was considered to be crucial when trying to effect change in the industry due to their authority in the workforce and their frequent contact with the workers. These findings echo those of many other construction research studies investigating the importance of senior management when effecting change; Levitt (1975), claimed that safety performance on construction sites can be strongly affected by the attitude of the top managers, Choudry & Fang (2008) claimed that 'workers believe nothing is possible without the involvement of management' and Hess et al., (2004) claimed that buy-in from management is essential to the success of any type of intervention. In a longitudinal study, Nielsen et al., (2004) found that active 'middle-manager' involvement led to an increase in job satisfaction and perceived wellbeing of workers. These previous findings and those of this research suggest that a resource should be tailored towards the 'top end' of the construction workforce (managers and supervisors), providing guidelines on how to encourage engagement and idea generation from the trades' workers in their workforce.

Several participants suggested that for a resource to encourage awareness of health and wellbeing at work and to facilitate discussions and idea generation to improve the design of jobs and workplaces for healthy ageing, it should be strongly focussed on health rather than safety. Both senior stakeholders and trades' workers acknowledged that 'safety' often takes priority over health on construction sites, which is supported by Waterman (2014) who said 'health is often whispered while safety is shouted'. Participants had good ideas to encourage health promotion such as a visiting medical van on site and weight loss and healthy eating competitions, suggestions which support the ongoing work of Dame Carol Black who says that healthy workforces can be encouraged through good work, good workplaces, engagement of staff, training of managers and attention to positive mental health, all of which will simultaneously improve safety (Black, 2014). Some trades' workers spoke about the appointment of a 'health champion' to engage with the workforce about their health and wellbeing at work, an initiative which has previously been suggested in several research studies to encourage small but important changes (Langford et al., 2000; Kramer et al., 2009; Gyi et al., 2013; Malinen & Johnston, 2013). Additional suggestions from participants included inviting various external visitors to present to the workers such as charities like Cancer Research and MacMillan nurses. No previous research studies have been found on the impact of external visitors to construction sites, however these suggestions would contribute to maintaining a variety of techniques with workers to sustain the workforces' attention, which was considered to be crucial by senior stakeholders.

Participants in all workshops discussed the success of previous campaigns in engaging the workforce in their health and wellbeing. Poster campaigns were considered to be a good way of publicising interventions and increasing awareness, however as previously discussed, continuity of the communication is essential. These ideas supported those of Feeney (1986) who found that the use of posters and videos was initially successful in increasing the use of personal protective equipment in hazardous situations; however these changes were not maintained long term. It was concluded that in order to maintain changes, approaches must be novel and varied (Feeney, 1986). Sawacha et al., (1999) also found that poster campaigns and 'fear techniques', such as the use of hard hitting statistics suggested by trades' workers in the workshops, are considered to be good ways of counteracting negative attitudes towards health and safety. Poster campaigns are also a common way of alerting and informing workers of upcoming events and interventions and have been used in several previous research studies (de Jong & Vink, 2002; Driessen et al., 2008; Brosseau et al., 2014).

An important problem identified by participants about the introduction of a resource encouraging workers to engage with their health and wellbeing at work and suggest changes to their jobs and workplaces was the fear of job loss. Trades' workers were concerned that if they were found to have a health problem that may prevent them from working safely, they may end up out of work or that if they were to suggest changes to their jobs or workplaces their supervisors may ask them to leave or at least make their jobs more difficult for them. Construction is well known for having a 'macho' culture, where heavy manual labour is commonplace and workers often 'downplay' any work-related ailments (Feeney, 1986; Watts, 2007); Kramer et al., (2010) also claimed that this 'macho factor' becomes apparent if an idea or suggestion is perceived to be 'whimpy' by the workforce, which hinders its success in being implemented. Workers' being afraid to admit change is necessary to improve their health and wellbeing at work was also called 'Tarzan syndrome' by Cederqvist & Lindberg (1993), where male workers would often be reluctant to prevent pain in their neck, shoulders and arms through ergonomic measures. Workers' fearing job loss as a result of either 'speaking up' to suggest changes in the workplace or health and wellbeing interventions in the workplace is not a new concern and has been identified in several previous research studies (Shephard, 1995; Love et al., 2010; Roelofs et al., 2011; Rioux & Mokounkolo, 2013). These findings indicate the importance of a resource being developed to engage with the workforce to encourage workers to want to take responsibility for their own health and wellbeing at work and also to harbour trusting relationships and communication channels between the workforce and supervisors to facilitate idea generation.

It was interesting to note that as workshops were held with trades' workers and senior stakeholders from three different construction organisations their perceptions of what would be possible in terms of the development of a resource was considerably varied. The workforce in the maintenance facility was permanent and paid a salary and their perceptions of job security were apparent during discussions of idea generation to improve health and wellbeing; workers in this facility were more receptive to the idea of suggesting changes to their supervisors compared to the trades workers in the domestic build company, who were employed on a temporary, sub-contractual basis. During workshops with trades' workers from the domestic build company, it was clear that they felt much more wary of making suggestions for changes to their jobs and workplaces as they felt this could cause tension between them and their supervisors. Being employed on a temporary basis meant that these workers perceived a much higher chance of being asked to leave site if they were to 'kick up a fuss' or suggest changes as there were 'plenty of other workers' available to do their job. Similarly, there were concerns about how to implement effective change with a constantly changing workforce. Another observed difference between the organisations was the types of initiatives that could be included in the resource; senior stakeholders in the domestic build company suggested improving existing toolbox talks to make them more interactive whereas the larger civil engineering company suggested a visiting medical van to site. As a result of discussions with both senior stakeholders, it appeared that the civil engineering company had a much larger budget for health and wellbeing initiatives compared to the domestic build company and the maintenance facility, this inevitably dictated different suggestions for the development of a resource for the industry. These findings suggest that it is essential that a resource is developed which enables construction organisations of any size and structure to engage with their workforce about their health and wellbeing at work. A variety of guidelines and recommendations should be made to ensure healthy working behaviours can be facilitated at any level and workers of any employment are encouraged to suggest ideas to improve their jobs and workplaces.

6.9 Limitations

The use of focus groups as a data collection method has been suggested to be limited in terms of its validity (Robson, 2011); bias may be present in terms of participants saying what they think the researcher wants to hear or alternatively some participants may not get the opportunity to put their opinions forward due to having louder members of the group. Despite these potential limitations, there appeared to be no concerns held by the participants in the workshops; post-it notes and an end of session questionnaire were used to capture any additional opinions that participants may not have had the chance to voice; however there was a minimal amount of new data collected using these methods.

Participants were selected using a purposive sampling strategy to ensure the most appropriate participants were included for data collection. Due to the peripatetic nature of construction workforces, very few trades' workers who had participated in the previous research study were available for participation in the workshops; to overcome this limitation, new trades' workers as well as workers previously involved in the research were given a small presentation on the context and background to the research including a summary of the findings of the previous research studies. Involvement of end-users was still achieved using new trades' workers and there was no obvious bias present within the selection of participants regarding their previous involvement.

The low attendance for the original workshop meant that the initial idea of holding a single workshop for a mixture of senior stakeholders and trades' workers did not happen. Despite this limitation, benefits were identified as a result of having separate workshops with trades' workers in that they appeared to be more honest and open with the researcher. During the workshops with trades' workers they admitted that suggesting changes to their supervisors and managers worried them and they feared repercussions such as job loss or their supervisors 'making their lives difficult'. Having one larger, mixed workshop may not have been as successful as smaller individual sessions.

Construction is an industry well-known for being difficult to change; although previous interventions have been shown to be successful in this industry, participatory interventions have been more successful in a shorter period of time in other industries due to the more permanent nature of the workforce. The construction workforce is often temporary and transient, meaning that engaging workers for positive results in a short time periods can be difficult. As a result, senior stakeholders and trades' workers may have struggled to suggest ideas for the development of a resource if they felt it would not be very well received within the workforce. Nevertheless, the inclusion of end-users in these discussions may increase the potential success of a resource due to the perceived level of input by the trades' workers and senior stakeholders.

6.10 Conclusions

The results of this research study support the following conclusions:

- A resource encouraging engagement and interaction of the workforce as well as improving workers' awareness of their health and wellbeing would be welcomed by both senior stakeholders and trades' workers in the industry.
- Senior stakeholders and trades' workers in construction feel that for a resource to be successful in the industry it must be visual, engaging and health-related; these factors would encourage engagement of the workforce and facilitate idea generation for healthy working practices to ensure longer healthier working lives.
- For a resource to be successful and to maintain the interest of the workforce a variety of methods should be used to convey health-related information such as interactive toolbox talks, discussions, poster campaigns, videos and external visitors. Communication and feedback between senior stakeholders and trades' workers about ideas, suggestions and ongoing interventions and campaigns needs to be consistent.
- Supervisors are essential when engaging and communicating with the workforce as they have the most frequent and regular contact with trades' workers and a campaign or intervention without their buy-in is unlikely to be as successful. Therefore a resource developed for their information is recommended.

Senior stakeholders and trades' workers of all ages expressed enthusiasm about engaging with a resource to encourage awareness and understanding of health and wellbeing at work. Construction trades' workers and senior stakeholders alike, acknowledge the importance of healthy working behaviours to facilitate longer working lives in the industry and all have good ideas for the development of a resource to encourage this. A recommendation for a resource to have impact in the industry and be effective in facilitating longer working lives is for it to be visually engaging and interactive to capture and maintain the attention of the workforce. It should also have a strong emphasis on health to ensure appropriate messages are conveyed to the workforce and focus on facilitating communication and feedback between the workforce and supervisors, as they are considered to be crucial for knowledge transfer.

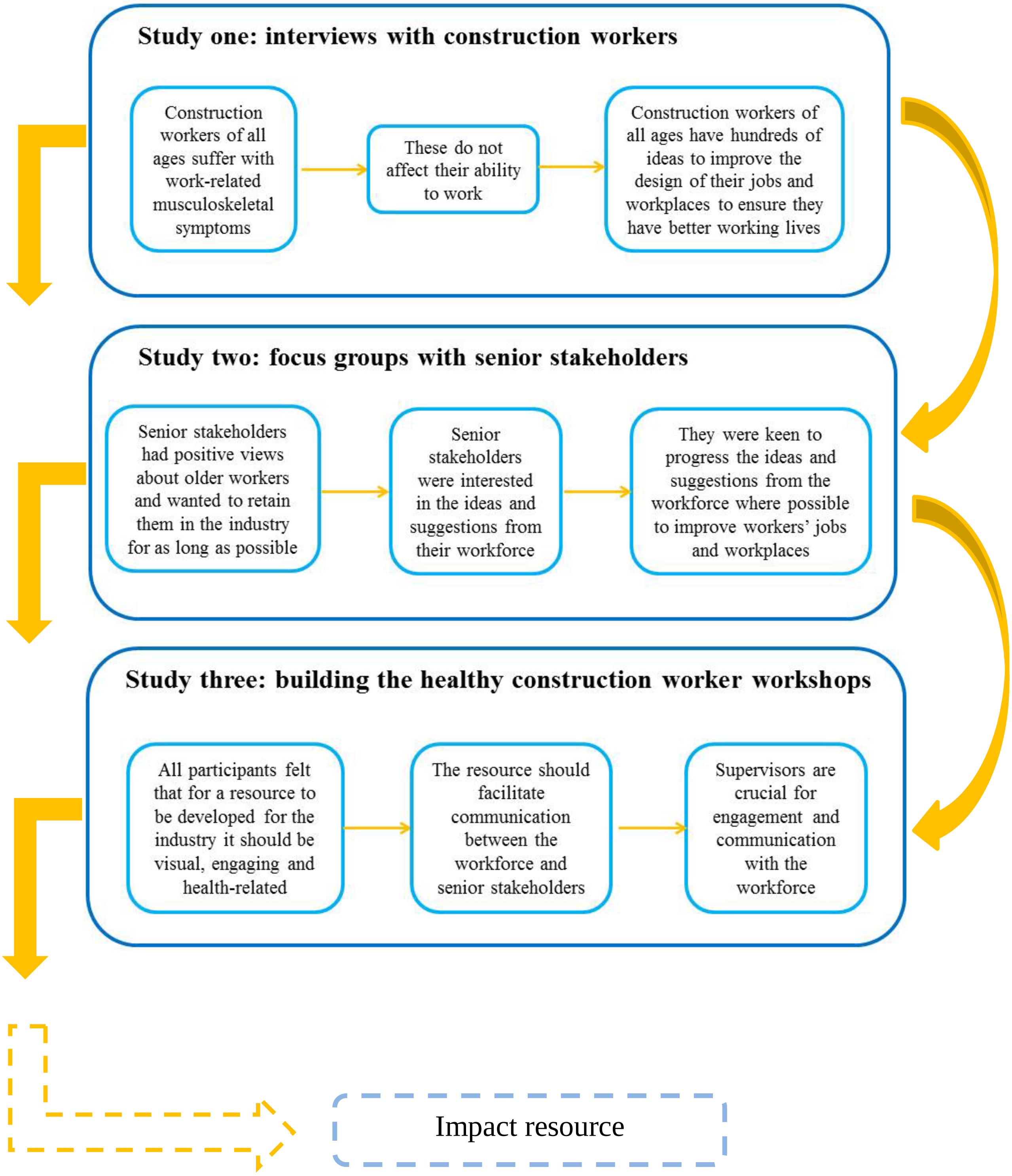
7. Summary, recommendations and conclusions

7.1 Summary

This research was sponsored by Age UK's 'Research into Ageing Fund' and explored how healthy ageing and longer, healthier working lives in the construction industry could be facilitated by harnessing the experience and knowledge of the construction workforce and capturing their ideas for improving their health and wellbeing at work through the design of their jobs and workplaces. The research presented in this thesis has addressed the objectives identified in Chapter 1. The previous literature and methodologies related to the study of construction workers and their health and wellbeing were explored and critically analysed (Objectives 1 and 2). A wide range of research evidencing the tough manual nature of construction work and the accompanying high risk of musculoskeletal ill health and injury was identified. These risks were found to be particularly prevalent in older workers, and a gap was identified regarding the part construction workers and senior stakeholders play in maintaining a good level of health, safety and wellbeing in their trades and the impact this can have on healthy ageing in construction. The understanding construction trades' workers have about their health and wellbeing at work was explored and ideas and suggestions they had to improve this were captured (Objectives 3 and 4). Opportunities and barriers to changes related to these suggestions were sought from senior stakeholders in the industry such as project managers and health and safety professionals in addition to their perceptions of older workers in the industry (Objective 5). Finally, a participatory approach was employed with end-users such as trades' workers and senior stakeholders; workshops were held to capture ideas for the development of an impact resource to facilitate healthy working behaviours (Objective 6).

This chapter summarises the research and formulates conclusions and recommendations based on the findings of the three studies presented in this thesis in conjunction with previous literature (Objective 7) and also presents the contribution to new knowledge based on these findings. Figure 43 illustrates the structure and relationship of the findings from each of the three studies and how each study is linked. The findings from all three research studies will ultimately contribute to a resource for dissemination to the construction industry.

Figure 43: The structure and relationship between the findings of research studies



Construction workers of all ages and trades suffer with musculoskeletal symptoms as a result of their work however this did not significantly affect their self-rated work ability. Evidence from Study One (Chapter 4) supports previous research that construction is a tough heavy manual industry, where there is a high risk of injury and ill health (Reid et al., 2001; Village & Ostry, 2010). However, contrary to previous research stating that this leads to early retirement from the industry (Arndt et al., 1996), Study One found that the construction workers involved in this research did not feel that these risks significantly affected their ability to work. Workers of all ages felt able to continue working to a high standard in their trades despite experiencing work-related aches and pains. Construction workers demonstrated a good understanding of their health at work, for example by acknowledging how heavy manual tasks such as lifting and digging can cause musculoskeletal problems in the knees and low back. Most workers counteracted these risks by coming up with ideas to improve their jobs and workplaces, such as job rotation, taking breaks, stretching before tasks, making up benches and using their tool bags as back supports. Although these findings may be subject to the 'healthy worker effect', (where participants available for interview will be inherently able to work, whereas those unable to work will not be available on site; see Chapter 4 for more details) this is still important in relation to the retention of workers in the industry. Construction trades' workers are keen to remain in work and feel they are more than capable of doing so. Both trades' workers and construction supervisors must continue to minimise the risks to musculoskeletal health when working in trades and ensure jobs and workplaces accommodate this in order that workers can remain in their trades for as long as they wish or for as long as they feel able to.

This research has found that construction workers of all ages have copious numbers of ideas to improve the design of their jobs and workplaces to ensure they can remain in work for as long as possible; this is a new contribution to knowledge. As previously discussed, the health, safety and wellbeing of construction workers has been well documented in research for many years. However a gap in the research was identified (Chapter 2) relating to the part workers can play in maintaining good health and wellbeing at work and subsequently how this can enable them to remain in work for longer. In Study One, the 80 construction workers interviewed across all ages had already made over 400 changes to their jobs and workplaces, such as changing methods and techniques, lifting, job rotation, preparing their workplaces and improving their health and fitness outside of work. They also had over 250 suggestions to improve their jobs and workplaces such as pension advice, more apprenticeships, access to medical advice on sites and health initiatives such as weight loss and healthy eating. A smaller number of workers (*n=25*) had come up with what they considered to be novel and unique ideas to specifically improve their jobs and workplaces. Examples of these included making up bespoke benches to alleviate poor postures, creating bespoke knee pads and modifying their high visibility jackets to eliminate the risk of snagging/catching it. Previous research has traditionally focused on individual areas of work or specific tasks to be improved, such as the working environment of crane operators (Wilson, 1995a), or the implementation of new devices (Vink et al., 1997; Vink et al., 2002; Hess et al., 2004) whereas findings from this research have evidenced the hundreds of ideas trades' workers have at little or no extra cost. There is currently a lack of research detailing construction workers' ability and ideas to improve their jobs and workplaces, therefore these findings are crucial for highlighting the value of workers' creativity and knowledge of their trades. It is also an important novel finding that construction workers are keen to share their ideas with their colleagues and supervisors which in turn could facilitate discussion about healthy working behaviours and encourage idea generation. This is important, as previous research has highlighted the positive outcomes of idea sharing between workers; Kramer et al., (2009) identified the importance of the social interactionist model, which claims that the more interaction and communication there is between individuals, the more opportunities there will be to share and make use of the knowledge they have.

Senior stakeholders had positive views about older workers and wish to retain them in the industry for as long as possible. They were interested in trades' workers' ideas and keen to progress them to improve workers' jobs and workplaces. These findings support those of previous research that older construction workers are highly valued in the industry due to their ability to contribute to knowledge and skill transfer. Subsequent to the gap in the research regarding the part construction workers can play in enabling longer and healthier working lives, there was also a lack of knowledge about how senior stakeholders felt this could be implemented in the industry. The findings from Study Two (Chapter 5) support the conclusion that senior stakeholders are keen to progress feasible suggestions from trades' workers to improve their job and workplace design. Examples of these include offering budget incentives to workers so that they could purchase better quality personal protective equipment (PPE); liaising with the workforce about the content and type of toolbox talks delivered to increase their impact; and improve communication between supervisors and the workforce to ensure ideas were always considered and responded to. The findings of this research also build upon those of previous studies which have shown that senior stakeholders such as supervisors and managers encouraging idea generation and idea sharing can lead to successful changes and improvements in working practices (Hess et al., 2004; Kramer et al., 2009); Study Two in particular demonstrated the willingness of stakeholders to harness and develop the ideas from their workforces into sustainable solutions.

Communication between the workforce and managers needs to be considerably improved in order to develop suggestions and ideas which could facilitate healthy working behaviours. Findings from all three studies presented in this thesis evidence this lack of communication. Study One found that trades' workers felt that there was no point in making suggestions to improve their job or workplace design as they felt they would not be listened to or that their ideas would not be developed. However, in Study Two, senior stakeholders expressed their surprise on learning ideas from the workforce such as them wanting to wear 'full face dust masks' rather than smaller masks, as the senior management had assumed trades' workers would prefer 'less' PPE rather than a larger piece of equipment as they already struggled to enforce the necessary regulations requiring workers to wear protection at all. They were also shocked to learn of workers' requests of better facilities such as showers, as senior stakeholders felt the current facilities were not used enough to warrant upgrades. In Study Three, during participatory workshops, both trades' workers and senior stakeholders acknowledged the importance of communication and identified supervisors as having a key role to play in this. Additional evidence of a lack of communication was the absence of feedback mechanisms which was hindering workers receiving information about the progress of any suggestions they had made. Clear examples of this were shown when the workers interviewed in Study One perceived money to be an important barrier to change in the construction industry, however in Study Two senior stakeholders rarely identified this as a major barrier.

This suggests that ideas from the workforce may be more readily put forward if workers felt that they were achievable; information given to them on opportunities and barriers such as budget needs to be more transparent. Construction is an industry notorious for transient workforces, contributing to poor communication; however the novel findings of this research evidence that mechanisms to aid communication of the relevant and useful ideas from the workforce should be improved.

Issues with communication did not just involve workers' perceived ability to put forward suggestions but a lack of communication was also identified regarding upcoming health and safety events and ongoing problems on sites such as maintenance works and updates to facilities. Older construction workers in particular were also concerned about the lack of knowledge transfer mechanisms for younger workers coming into the industry. Workers of all ages suggested an increase in toolbox talks and apprenticeships to encourage knowledge transfer, communication and ideas sharing which was supported by senior stakeholders in Study Two. Workers also suggested improvements in communication during daily 'start of shift' briefings, such as updates regarding upcoming events, for example medical van visits or charity talks. These findings reflect those of previous research; Gross (2015) encouraged trades' workers to share their experiences of ill health and injury during toolbox talks and, by encouraging the interaction, claimed that the audiences' attention would be held for longer and more information would be retained.

It is essential that good communication channels are created and maintained between the workforce and senior stakeholders to ensure feasible suggestions and ideas can be put forward and workers can receive timely, relevant feedback on their suggestions. For example in cases where money and budget constraints present barriers, senior stakeholders such as project managers may be able to suggest cheaper alternatives. This may positively reinforce idea generation with the workforce, increase trust between workers and managers and potentially implement successful change. For example, Gervais (2003) believed that "workers are reported to adopt safe behaviours when there is communication between them and their supervisors" and "construction sites can only be healthy workplaces if project directors define and unequivocally support specific safety objectives". Feedback has been shown to be essential in the introduction of intervention and change in the construction industry (Hess et al., 2004; Lombardi et al., 2009) and in other industries (Wilson & Grey-

Taylor, 1995; Punchihewa & Gyi, 2009; Caroly et al., 2010) as ‘it makes the participants aware of the reasons why choices are made’ (Vink et al., 1997). The importance of this finding is evidenced in all three research studies and shows that a lack of communication is hindering the development of healthy working behaviours in construction.

Study Three (Chapter 6) supported the finding that a resource to encourage healthy working behaviours and idea generation for longer working lives in the construction industry would be welcomed. However to ensure successful integration it must be visual and interactive to capture and maintain the attention of the workforce. This was found by using a bottom-up participatory approach to capture ideas from end-users such as construction trades’ workers and senior stakeholders. There is currently very little research and guidance in the construction industry to encourage idea generation in the workforce through the use of participatory approaches, which in turn could facilitate healthy working practices. The enthusiasm and engagement of the workers and senior stakeholders strongly suggests that healthy working behaviours can be facilitated which may encourage and enable workers to remain in their trades for as long as they feel able to; previous research has shown that involvement of end-users significantly increases the likelihood of success of intervention and change (Wilson, 1995a; Hignett et al., 2005).

7.2 Recommendations

The findings of this research indicate that there are a number of opportunities for the construction industry to harness the knowledge and experience of construction workers of all ages and to utilise their ideas and suggestions. These have the potential to improve trades’ workers’ health and wellbeing at work, possibly eradicating early retirement from the industry or at least enabling construction workers to remain in work for as long as their white collar industry counterparts. As a result, this section will provide recommendations in four areas:

1. Construction trades’ workers
2. Senior construction stakeholders
3. Future research
4. Further industries

7.2.1 Construction trades' workers

Study One has provided evidence that construction workers have extensive knowledge and experience of working in their trades, contributing to a high level of understanding about their health and wellbeing at work, which should be harnessed by the industry. Based on the findings of this research the following recommendations have been made:

- Construction workers have a good understanding of their health and wellbeing at work and should be encouraged to discuss these and suggest ideas to make their jobs safer, easier or more comfortable.
- Construction workers should put forward feasible suggestions to their supervisors to develop them further.
- Construction workers of all ages are experiencing work-related musculoskeletal symptoms therefore should share the knowledge and understanding they have of their musculoskeletal health with their colleagues, particularly younger construction workers.
- Construction workers should share changes they have made and ideas to improve their health and wellbeing at work with their colleagues.

Findings from both Study One and Study Two have contributed to the recommendation that trades' workers should suggest feasible changes to their supervisors, to ensure change can be implemented across the workforce and to encourage and maintain communication between themselves and senior stakeholders. A number of construction workers interviewed in Study One were found to have made changes unique to them, such as stretching before a physical task to warm up their muscles and attaching cable ties to the lapel of their jackets to make them easily accessible. Sharing ideas like this with their colleagues could also reduce their risk of injury, ill health and musculoskeletal symptoms and therefore should be encouraged. Based on the findings from Study One that construction workers of all ages and in all trades are experiencing musculoskeletal symptoms but not at a level that significantly affects their self-rated ability to work, it is recommended that construction workers are encouraged to share their level of understanding of their bodies at work and to continue making changes to minimise risk. It is clear from the findings of this research that workers have a good understanding of their health and wellbeing at work and are prepared to make proactive changes to maintain this. It is therefore recommended that they share this knowledge and understanding, particularly with younger construction workers, to encourage safe and healthy practices which facilitate healthy ageing.

7.2.2 Senior construction workers

In Study Two, senior stakeholders such as project managers, health and safety professionals and directors in the industry expressed their intention to build upon suggestions and ideas from their workers to improve the health and wellbeing of the workforce. These findings have led to the following recommendations:

- Senior stakeholders should facilitate discussion with the workforce about their health and wellbeing at work.
- Senior stakeholders recognise the knowledge and experience within their workforces and should encourage workers to put forward ideas and suggestions to improve their jobs, workplaces and health and wellbeing at work.
- Senior stakeholders should ensure communication/feedback mechanisms are in place to inform workers about the progress of their ideas and suggestions.

The findings from Study Two highlight the crucial importance of communication and feedback mechanisms to ensure idea generation from the workforce. Discussions with the workforce could be facilitated through a variety of mediums such as toolbox talks, 'start of session' briefings, site inductions or books/comment cards where workers can write their suggestions down. Previous research has shown that if workers feel involved in a process, it is more likely to be successful across the workforce, therefore mechanisms should be in place to ensure managers and supervisors provide feedback to workers on their suggestions on a regular basis, to reassure workers that they are being taken seriously and further encourage them to consider their health and wellbeing at work.

7.2.3 Future research opportunities

It is well documented that construction workers are prone to ill health and injury due to the heavy nature of their work (Arndt et al., 2005) and that the work ability of workers in heavy manual industries declines at a steeper rate of those in white collar industries (Capanni et al., 2005). Nevertheless, this research has shown that construction workers of all ages and in all trades have a good understanding of their health and wellbeing at work. The working population is ageing quickly and it is therefore essential that the health and wellbeing of workers of all ages is seriously considered now so that they can have longer, healthier working lives. Previous research studies using participatory approaches in the construction industry have generally focused on specific interventions, such as the implementation of new devices (Vink et al., 1997; Vink et al., 2002; Hess et al., 2004) or modifying the design of the workplace for crane operators (Wilson, 1995a). This research has added to previous knowledge, by demonstrating that not only are construction workers keen to remain in work, but they have good, feasible ideas to improve their health and wellbeing at work to facilitate longer working lives (Eaves et al., 2016). Workers of all ages are keen to make changes to the design of their jobs and workplaces so that they are able to live longer, healthier working lives in their trades.

Future research in this area is essential to ensure construction workers of all ages are aware of their health and wellbeing at work in order to maintain healthy working lives. Awareness must be increased not only with trades' workers but also with senior stakeholders such as managers, supervisors and health and safety professionals to ensure changes can be implemented across the industry. Early retirement from the industry through injury and ill health can be avoided if more research is conducted to improve awareness and understanding of workers' health at work. Based on this, the recommendations for future research opportunities are:

- Conduct further research with senior construction stakeholders to explore appropriate ways to judge whether suggestions from workers would be feasible.
- Employ a full participatory approach, using a framework such as the Participatory Ergonomics Framework (PEF) (Haines et al., 2002), to implement ideas from the workforce.
- Promote ideas and changes suggested by the workforce using in-depth case studies and use these to inform future interventions.

Findings from this research have shown that senior stakeholders are willing to develop the ideas and suggestions from their workforce into sustainable solutions. An example of this was workers complaining about the poor quality of their PPE and suggesting a budgetary incentive to improve this. Senior stakeholders acknowledged this problem and developed the suggestion by offering workers the opportunity to 'top up' the budget for PPE on site with their own salary, thus allowing them to 'upgrade' their equipment. Capturing suggestions and ideas in the form of in-depth case studies using a participatory approach is a recommendation for future research. The use of a Participatory Ergonomics Framework (PEF) (Haines et al., 2002) would allow for in-depth analysis of the approach when used with construction workers and their own ideas. The PEF has 9 different dimensions such as the permanence of the initiative, involvement of participants in the intervention and the level of influence the intervention is involved at. It can serve as a 'check list' to facilitate successful change using a participatory approach, to ensure all participants understand the on-going process. Using this approach has been shown to increase 'buy-in' of ideas and in turn encourage further idea generation and involvement of the workforce.

7.2.4 Other industries

It is important to note that some of the findings of this research can be applied in other industries/areas and may be relevant when considering the health and wellbeing of workers to ensure longer working lives. Based on these, the following recommendations are for other industries:

- Encourage the workforce to share and discuss ideas with colleagues and managers to improve knowledge transfer within an organisation.
- Ensure that there are good communication channels between the workforce and senior managers and that high levels of feedback are maintained.
- Make use of surveys such as the Nordic Musculoskeletal Questionnaire and the Work Ability Index, as they can encourage workers to think about and consider their health and wellbeing at work.

The findings from this research have shown that encouraging workers to share and discuss their ideas with their colleagues and senior stakeholders can lead to positive outcomes for workers of all ages. Many industries can benefit from implementing these approaches within their workforces. Indeed, participatory ergonomics has been shown to be successful in a number of different industries, where involving end-users in design decisions and encouraging involvement and idea generation has led to the development of successful interventions, such as white collar office work (Vink et al., 1995), the nuclear industry (dos Santos et al., 2011) assembly workers (Miguez et al., 2012), kitchen workers (Pehkonen et al., 2009), business drivers (Gyi et al., 2013) and meat processors (Tappin et al., 2016). The findings of this research have highlighted the particularly important benefits of knowledge transfer and idea sharing within workforces, to encourage workers of all ages to consider how they intend to age healthily within the context of their own jobs.

The findings have also highlighted the crucial importance of good communication between members of the workforce and senior stakeholders such as supervisors and managers. Other industries could also significantly benefit from implementing good communication channels within their workforces, to ensure their workers feel comfortable suggesting changes to their jobs or workplaces which could improve their health and wellbeing at work. The data collection methods used for this research, such as interviews, focus groups and workshops with both trades' workers and senior stakeholders can also be used in a variety of industries. They can be used to both capture ideas from the workforce and also develop these with senior stakeholders to explore their feasibility. These methods can also be used to encourage regular communication, idea generation and feedback within the workforces. In addition to this, the use of the NMQ (Kuorinka et al., 1987) allowed workers to consider any musculoskeletal symptoms they were suffering with as a result of their work, which in turn facilitated discussion about what they are doing (if anything) to alleviate these symptoms. This approach can be used in other industries, such as office workers, assembly workers or in the retail industry to understand the mechanisms that workers put in place themselves to maintain their health and wellbeing at work.

7.3 Impact resource

Study Three evidenced interest from both trades' workers and senior stakeholders in the industry in a resource to encourage engagement, communication and discussion of healthy working in construction. Through participatory workshops, ideas from trades' workers and senior stakeholders were captured for the development of such a resource and based on these findings the following recommendations have been formulated:

- The resource should be visually engaging and strongly health-related to maintain the interest of trades' workers and supervisors, as it is felt that the industry is already saturated with information regarding 'safe working'.
- The resource should be tailored towards supervisors as they play a key role in communicating with trades' workers and senior stakeholders such as site and project managers.
- The resource should facilitate discussion and idea generation about healthy working practices and design ideas from workers of all ages and trades as it has been evidenced that they have good ideas to improve these.

A resource encouraging visual engagement is likely to be more successful within construction workforces in order to capture and maintain the attention of the workers and encourage interaction. It was also acknowledged that the use of technology such as websites and mobile phone apps may restrict involvement from older workers who may not be as 'technology-savvy' as younger workers. Therefore a resource containing guidelines for interactive toolbox talks, suggestions for change and facilitating discussion about health and wellbeing at work may be more effective, as workers of all ages and abilities can be involved in these. The research presented in this thesis has shown that construction workers of all ages and trades have good ideas to improve their health and wellbeing at work, which may have the ability to minimise early retirement from the industry due to ill health. In addition, trades' workers and senior stakeholders alike would be keen to harness these ideas and make use of an impact resource if it contained guidelines of how to maximize the knowledge, experience and ideas held by the workforce.

A preliminary draft version of the impact resource can be found in Appendix A23.

7.4 Contribution to knowledge

There has been a wealth of previous research evidencing the health risks of working in the construction industry; it is well-known for heavy manual labour with a high risk of health problems such as musculoskeletal disorders, skin and respiratory diseases, hand-arm vibration disorders and noise-induced hearing loss. Despite this, a gap in the literature was identified concerning construction workers' understanding of their health at work and the ideas they have to make their jobs and workplaces safer, easier and more comfortable. Traditionally, health and safety has used a 'top-down' approach, with project managers and health and safety professionals creating rules for site safety. The research presented in this thesis evidences the wide range of knowledge, experience and ideas held by construction trades workers of all ages, suggesting that a 'bottom up' approach, co-developing solutions with trades' workers could be effective in encouraging healthy working behaviours. This research also found that managers and senior stakeholders were keen to develop workers' ideas, and their support in the implementation of change in the industry is crucial. This research presents a contribution to knowledge that the experience and creativity of the construction workforce can be harnessed and utilised to improve the health and wellbeing of workers in the industry, which can in turn be used to facilitate healthy working behaviours and healthy ageing. This research also presents the opportunity to further contribution to knowledge; specific ideas suggested by the workforce could be implemented and the success of any changes made could be measured by assessing levels of engagement, productivity and the overall health and wellbeing of the workforce such as prevalence of musculoskeletal disorders, disease and work ability. In light of an ageing population and an ageing workforce, it is essential that workplaces accommodate workers of all ages and facilitate healthy ageing.

7.5 Conclusions

Construction workers of all ages have demonstrated a good understanding of their health at work and suggested a large variety of ideas to improve their jobs and workplaces to make them safer, easier or more comfortable. Senior stakeholders in the construction industry have acknowledged these ideas and expressed their interest in developing them further to retain trades' workers in the industry and to facilitate healthy working practice. Construction trades' workers and senior stakeholders' ideas for an impact resource have been captured to provide guidance on worker engagement, idea generation and facilitation of discussions about health and wellbeing at work. The following conclusions are derived from the research in this thesis:

- Workers of all ages suffer from musculoskeletal symptoms in all areas of the body, but nevertheless have high self-ratings of work ability (Chapter 4).
- Workers of all ages have good ideas to improve the comfort, safety and ease of their jobs in order to maintain a good level of health and wellbeing in their trades (Chapter 4).
- Workers want to remain fit and healthy at work to ensure they are not forced into early retirement as a result of ill health or musculoskeletal disorders. Workers of all ages are keen to share ideas they have for modification to their jobs and workplaces to enable this (Chapter 4).
- Senior stakeholders are open to ideas and suggestions from their workforces and where possible, will try to progress their suggestions to improve their jobs and workplaces (Chapter 5).
- Communication between the workforce and senior stakeholders such as managers and supervisors needs to be considerably improved in order for healthy working behaviours and longer working lives to be facilitated (Chapter 5).
- An impact resource for use in the construction industry would be welcomed. However, to ensure the integration and success of such a resource it must be visual and interactive in order to capture and maintain the attention of trades' workers (Chapter 6).

8. Discussion of findings within wider literature

8.1 Introduction

This chapter serves to bring together the key issues from the research presented in this thesis and place them within the wider literature of male ageing, health and change behaviours in heavy industries.

8.2 Gender differences

Construction is dominated by a male workforce, which was reflected within the sample of participants involved in the research. Due to this gender bias within the industry and many other heavy manual industries such as firefighting and agriculture, it is essential that gender differences are considered. Men and women age differently, which will have an effect on the type of and success of health and wellbeing initiatives introduced to male dominated workforces. As previously discussed, the way we age is largely dependent on the way we live our lives; intrinsic factors such as genetics as well as extrinsic factors such as lifestyle, exercise and diet will all effect our health and wellbeing over our lifespan. The general historic view of ageing is that women have longer life expectancies in comparison to men as a result of slower senescence (Olshansky and Carnes, 1994; Carey, 2003; Graves et al., 2006). It has been identified that whilst men are stronger and have fewer disabilities, they have a substantially higher mortality rate in comparison to women and are more likely to suffer with severe chronic diseases in comparison to women (Verbrugge & Wingard, 1987; Oksuzyan et al., 2008). These gender differences can be exacerbated in heavy manual industries and this has been seen in previous research, where men have been known to leave the construction industry before retirement age due to injury or ill health (Arndt et al., 2005).

Courtenay (2000) believes that these gender differences in health can be partly explained by differences in health behaviours exhibited by males and females. A review was conducted which found that men are more likely to engage in over 30 risky behaviours conducive to poorer health and lower life expectancy in comparison to females (Courtenay, 2000). Powell-Griner et al., (1997) found that men are less likely to have health screenings and are more likely to smoke and drink compared to women. Women are also more likely to engage in health promoting behaviours such as frequent exercise and healthy eating (Walker et al., 1988; Kandrack et al., 1991) and as a result are less likely to be overweight (Powell-Griner et al., 1997).

The risky health behaviours exhibited by men have been attributed to gender stereotyping, which is considered to be a basis ‘for the beliefs about who men and women innately are’ (Pleck, 1987; Williams & Best, 1990). Historically men are viewed as, and are expected to be independent, powerful, masculine and strong (Golombok & Fivush, 1994; Martin, 1995) which has profound effects on their health and risk taking behaviours. Previous research has shown that often men refuse to admit to or acknowledge pain in a plight to gain power (Kaufman, 1994) and that it is not unusual to hear a man ‘brag’ about how he has ‘not been to a doctor in years’ (Courtenay, 2000). As construction is a male dominated industry, these attitudes can be seen throughout workforces in all organisations, making interventions to facilitate and encourage health, wellbeing and healthy ageing very difficult to introduce. This was also seen in the research presented, with workers discussing their use of Personal Protective Equipment (PPE). Construction workers felt it was all down to ‘common sense’. They also had a very ‘macho’ attitude when discussing their aches and pains at work, claiming that it is ‘just part of the job’ and if you didn't like it ‘you could always become a ballerina’.

These gender stereotypes and exhibited behaviours are not uncommon in the male dominated construction industry; risk taking behaviours are frequently seen on site by both older workers who ‘think they know better’ and by younger workers who are able to work quicker as a result of being stronger and having more stamina than older workers. Older workers interviewed for this research believed that younger workers were naive to the damage they could be doing to their bodies. These behaviours have been previously investigated and been found to manifest themselves as ‘Tarzan Syndrome’. Levinsen (2003) provided an example of this when speaking to workers about removing their safety goggles; workers were aware of the risks involved when removing their safety goggles however were totally unwilling to discuss the potential for accidents and their consequences.

8.3 Interventions in manual industries

These kinds of attitudes have been seen to a lesser extent in other physical labour domains such as manufacturing, agriculture and firefighting. In fact, interventions and change introduced to help workers improve their health and wellbeing have been relatively well received in these industries. One-day workshops with farmers led to improvements in living conditions, working conditions and welfare (Kogi, 2006) and apple harvest workers responded positively towards an intervention introduced to reduce back strain, there were no reports of participants being uncooperative (Earle-Richardson et al., 2005). Despite initial resistance from the workers on a production line in BMW, the participatory approach used with the workforce led to over 70 changes being made to improve their job and workplace design (Loch et al., 2010) and health and wellbeing initiatives were well received in the firefighting industry with participants increasing their general wellbeing and fruit and vegetable consumption after an intervention (Elliot et al., 2007).

In contrast there have been mixed findings in construction research; whilst some intervention studies have proven successful (Ludewig & Borstad, 2003; Mirka et al., 2003; Hess et al., 2004; Holmström & Ahlborg, 2005) others have had more diverse outcomes. Interventions introduced with scaffolders did decrease workers' heart rates and the heaviness of work however when it came to evaluating the interventions, less than half of the participants filled out the questionnaire (the reason for this was not given) (Vink et al., 1997). The findings which report successful interventions provide very little detail on how open construction workers were to discussing their health. In the research presented in this thesis limitations have been highlighted such as construction workers potentially 'playing down' their aches, pains and health issues during interviews in order to maintain the 'macho' gender stereotype. There was also fear of job loss cited by workers as a reason for not disclosing all their health worries. This can make health research in the construction industry very difficult; more longitudinal research with regular occupational health professionals may form more trusting relationships with workers and lead to more in-depth health data being collected. Interestingly, 'building trust' was considered to be an important mechanism for moving forward by the senior stakeholders involved in the research presented in this thesis. It was felt that by improving communication and having transparent information channels; trades' workers may feel more comfortable suggesting changes for their health and wellbeing at work.

8.3.1 Change behaviour

An important factor related to change behaviour and the success of interventions is workers' previous life experiences. Many workers in this research displayed the attitude of 'it hasn't killed me yet so why should I stop doing it'. 'Survivor theory' has been extensively researched with the smoking behaviours of cancer survivors; Evangelista et al., (2003) found that although 81% of lung cancer survivors quit smoking after their diagnosis, 13.4% continued to smoke, providing some evidence for 'survivor theory'. Similarly, Bauld et al., (2005) found that young cancer survivors were at an increased risk of reporting pain reliever use for non-medical purposes and Coups et al., (2005) found that cancer survivors had high levels of physical inactivity and dietary risk factors. This theory may also explain construction workers' aversion to wearing Personal Protective Equipment at work, which was expressed by some of the workers interviewed in this research. Older workers, scaffolders and bricklayers in particular did not see a benefit in changing their behaviours at work as their trades' practices had not changed in 'hundreds of years'. These attitudes could be overcome by increasing interactive sessions with workers using empathic devices such as goggles simulating eye injuries and gloves simulating the effects of dermatitis.

8.3.2 Transient workforces

Another difficulty with introducing interventions to improve health, wellbeing and healthy ageing in construction is the transient workforce. The majority of construction workers are self-employed and workers are often working themselves out of jobs as construction sites develop (Ringen et al., 2005). Despite this some previous interventions have been successful with construction workforces; in the research in this thesis, construction workers and industry stakeholders were keen to develop ideas and had suggestions to encourage healthy ageing in the workplace. Ultimately, it would seem that the success of health interventions is down to the organisation and the culture of the workforce in addition to the attitude of individuals. An intervention such as the use of barrier cream to maintain healthy skin on the hands could potentially be very effective if workers are open to its use; supervisors fully explain the benefits; and the organisation ensures that the cream is readily available to workers on site throughout the day. As previously discussed, there are a multitude of factors which could affect an individuals' openness to change; those which were discussed in this research included workers getting older and wanting to take care of themselves more, having a family to support and therefore wanting to be healthier and being fitter and healthier to remain in work for longer. Conversely, the main factor which worked against change for individuals included elements of survivor theory, 'it's never done me any harm before' and barriers within the organisation such as a lack of support from the senior stakeholders. Therefore for interventions to be successful in the construction industry, continuity across workforces and worksites is key. If organisations worked together this may present a more united front for trades' workers, who would come to expect a standard across all sites.

8.4 Personal Protective Equipment

This unity across construction organisations could also have positive effects on the design and requirements of Personal Protective Equipment (PPE). A common suggestion for change from trades' workers interviewed for this research was to improve the design and quality of PPE such as gloves, boots, high vis jackets and goggles. The Health and Safety Executive (2013) released 'Harmonised European Standards for Personal Protective Equipment' and stated that only equipment which meets these requirements is entitled to be sold for use. These standards contain design, performance and marking requirements of equipment (HSE, 2013). Examples include safety footwear having the basic requirements of a toecap with 'penetration resistance', insulation against both heat and cold with uppers resistant to water penetration / absorption and outsoles resistant to hot contact (HSE, 2013). Although standards such as these are in place, it is clear from this research that there is a lack of uniformity across the construction industry. Trades' workers are required to wear different types of PPE dependent on the organisation they are working for and site they are working on at the time, causing confusion and a lack of consistency. For interventions and change to be successful, stricter regulations need to be in place across the industry. Stakeholders suggested more transparent discussions with workers about the budget for PPE so solutions could be co-developed to improve the situation.

8.5 Organisational culture

The culture of an organisation is not only partially responsible for the success of interventions but also for reinforcing ageist stereotypes. As previously discussed in this thesis (Chapter 2, section 2.2), organisations may claim they do not have an age bias but may behave very differently in practice. In construction this can be a particular issue where workers are often paid based on their productivity, which can be problematic when younger workers can work at a faster pace in comparison to older workers. Nevertheless, older construction workers are highly valued in the industry for their extensive knowledge and experience in their trades (Leaviss et al., 2008b). Industry stakeholders consulted in this research echoed these findings and were aware of important of knowledge transfer in the workforce, between older and younger trades' workers. De Blois (2013) found that older workers have a slightly negative perception of younger workers, which was also found in the research presented in this thesis. These findings may hinder knowledge transfer systems, if older workers feel they will not be listened to. However De Blois (2013) also found that older workers were willing to pass on knowledge to younger workers, also confirmed in the current research, providing a sound basis for this type of intervention in the construction workplace. In further support of this, industry stakeholders consulted in this research were keen to develop the ideas and suggestions from their workforce, providing strong evidence that change can be effective if communication and engagement of the workforce is facilitated.

8.6 Summary

Overall, the research presented in this thesis suggests that the construction industry differs slightly from other industries; in a male dominated industry, it is common for strong male stereotypes to prevail and for trades' workers to 'play down' injury and ill health. This may be attributed to the transient workforce in construction which may create difficulties in maintaining interventions across different organisations. This thesis provides significant new information about the range of good ideas to improve job and workplace design from construction workers of all ages and their willingness to put these forward to improve health and wellbeing at work and therefore encourage healthy ageing. The construction industry has the opportunity to take advantage of ideas coming from the workforce themselves, as previous research has shown that a sense of ownership can significantly increase buy-in and the success of interventions which could significantly improve male ageing in the construction industry.

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Appendices

A1: Pluye's mixed methods appraisal tool (MMAT) (Pluye et al., 20110

McGill

Mixed Methods Appraisal Tool (MMAT) – Version 2011
For dissemination, application, and feedback: Please contact pierre.pluye@mcgill.ca, Department of Family Medicine, McGill University, Canada.

The MMAT is comprised of two parts (see below): criteria (Part I) and tutorial (Part II). While the content validity and the reliability of the pilot version of the MMAT have been examined, this critical appraisal tool is still in development. Thus, the MMAT must be used with caution, and users' feedback is appreciated. Cite the present version as follows.

> Pluye, P., Robert, E., Cargo, M., Bartlett, G., O'Cathain, A., Griffiths, F., Boardman, F., Gagnon, M.P., & Rousseau, M.C. (2011). *Proposal: A mixed methods appraisal tool for systematic mixed studies reviews*. Retrieved on [date] from http://mixedmethodsappraisaltoolpublic.pbworks.com. Archived by WebCite® at http://www.webcitation.org/5tTRTc9yJ

Purpose: The MMAT has been designed for the appraisal stage of complex systematic literature reviews that include qualitative, quantitative and mixed methods studies (mixed studies reviews). The MMAT permits to concomitantly appraise and describe the methodological quality for three methodological domains: mixed, qualitative and quantitative (subdivided into three sub-domains: randomized controlled, non-randomized, and descriptive). Therefore, using the MMAT requires experience or training in these domains. E.g., MMAT users may be helped by a colleague with specific expertise when needed. The MMAT allows the appraisal of most common types of study methodology and design. For appraising a qualitative study, use section 1 of the MMAT. For a quantitative study, use section 2 or 3 or 4, for randomized controlled, non-randomized, and descriptive studies, respectively. For a mixed methods study, use section 1 for appraising the qualitative component, the appropriate section for the quantitative component (2 or 3 or 4), and section 5 for the mixed methods component. For each relevant study selected for a systematic mixed studies review, the methodological quality can then be described using the corresponding criteria. This may lead to exclude studies with lowest quality from the synthesis, or to consider the quality of studies for contrasting their results (e.g., low quality vs. high).

Scoring metrics: For each retained study, an overall quality score may be not informative (in comparison to a descriptive summary using MMAT criteria), but might be calculated using the MMAT. Since there are only a few criteria for each domain, the score can be presented using descriptors such as *, **, ***, and ****. For qualitative and quantitative studies, this score can be the number of criteria met divided by four (scores varying from 25% (*) -one criterion met- to 100% (****) -all criteria met-). For mixed methods research studies, the premise is that the overall quality of a combination cannot exceed the quality of its weakest component. Thus, the overall quality score is the lowest score of the study components. The score is 25% (*) when *QUAL=1 or QUAN=1 or MM=0*; it is 50% (**) when *QUAL=2 or QUAN=2 or MM=1*; it is 75% (***) when *QUAL=3 or QUAN=3 or MM=2*; and it is 100% (****) when *QUAL=4 and QUAN=4 and MM=3* (QUAL being the score of the qualitative component; QUAN the score of the quantitative component; and MM the score of the mixed methods component).

Rationale: There are general criteria for planning, designing and reporting mixed methods research (Creswell and Plano Clark, 2010), but there is no consensus on key specific criteria for appraising the methodological quality of mixed methods studies (O'Cathain, Murphy and Nicholl, 2008). Based on a critical examination of 17 health-related systematic mixed studies reviews, an initial 15-criteria version of MMAT was proposed (Pluye, Gagnon, Griffiths and Johnson-Lafleur, 2009). This was pilot tested in 2009. Two raters assessed 29 studies using the pilot MMAT criteria and tutorial (Pace, Pluye, Bartlett, Macaulay et al., 2010). Based on this pilot exercise, it is anticipated that applying MMAT may take on average 15 minutes per study (hence efficient), and that the Intra-Class Correlation might be around 0.8 (hence reliable). The present 2011 revision is based on feedback from four workshops, and a comprehensive framework for assessing the quality of mixed methods research (O'Cathain, 2010).

Conclusion: The MMAT has been designed to appraise the *methodological quality* of the studies retained for a systematic mixed studies review, not the quality of their *reporting* (writing). This distinction is important, as good research may not be 'well' reported. If reviewers want to genuinely assess the former, companion papers and research reports should be collected when some criteria are not met, and authors of the corresponding publications should be contacted for additional information. Collecting additional data is usually necessary to appraise *qualitative research and mixed methods studies*, as there are no uniform standards for reporting study characteristics in these domains (www.equator-network.org), in contrast, e.g., to the CONSORT statement for reporting randomized controlled trials (www.consort-statement.org).

Authors and contributors: Pierre Pluye[1], Marie-Pierre Gagnon[2], Frances Griffiths[3] and Janique Johnson-Lafleur[1] proposed an initial version of MMAT criteria (Pluye et al., 2009). Romina Pace[1] and Pierre Pluye[1] led the pilot test. Gillian Bartlett[1], Belinda Nicolau[4], Robbyn Seller[1], Justin Jagosh[1], Jon Salsberg[1] and Ann Macaulay[1] contributed to the pilot work (Pace et al., 2010). Pierre Pluye[1], Émilie Robert[5], Margaret Cargo[6], Alicia O'Cathain[7], Frances Griffiths[3], Felicity Boardman[3], Marie-Pierre Gagnon[2], Gillian Bartlett[1], and Marie-Claude Rousseau[8] contributed to the present 2011 version.

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A2: Pluye's mixed methods appraisal tool (MMAT) continued

Types of mixed methods study components or primary studies	Methodological quality criteria (see tutorial for definitions and examples)	Responses			
		Yes	No	Can't tell	Comments
Screening questions (for all types)	• Are there clear qualitative and quantitative research questions (or objectives*), or a clear mixed methods question (or objective*)?				
	• Do the collected data allow address the research question (objective)? E.g., consider whether the follow-up period is long enough for the outcome to occur (for longitudinal studies or study components).				
	Further appraisal may be not feasible or appropriate when the answer is 'No' or 'Can't tell' to one or both screening questions.				
1. Qualitative	1.1. Are the sources of qualitative data (archives, documents, informants, observations) relevant to address the research question (objective)?				
	1.2. Is the process for analyzing qualitative data relevant to address the research question (objective)?				
	1.3. Is appropriate consideration given to how findings relate to the context, e.g., the setting, in which the data were collected?				
	1.4. Is appropriate consideration given to how findings relate to researchers' influence, e.g., through their interactions with participants?				
2. Quantitative randomized controlled (trials)	2.1. Is there a clear description of the randomization (or an appropriate sequence generation)?				
	2.2. Is there a clear description of the allocation concealment (or blinding when applicable)?				
	2.3. Are there complete outcome data (80% or above)?				
	2.4. Is there low withdrawal/drop-out (below 20%)?				
3. Quantitative non-randomized	3.1. Are participants (organizations) recruited in a way that minimizes selection bias?				
	3.2. Are measurements appropriate (clear origin, or validity known, or standard instrument; and absence of contamination between groups when appropriate) regarding the exposure/intervention and outcomes?				
	3.3. In the groups being compared (exposed vs. non-exposed; with intervention vs. without; cases vs. controls), are the participants comparable, or do researchers take into account (control for) the difference between these groups?				
	3.4. Are there complete outcome data (80% or above), and, when applicable, an acceptable response rate (60% or above), or an acceptable follow-up rate for cohort studies (depending on the duration of follow-up)?				
4. Quantitative descriptive	4.1. Is the sampling strategy relevant to address the quantitative research question (quantitative aspect of the mixed methods question)?				
	4.2. Is the sample representative of the population understudy?				
	4.3. Are measurements appropriate (clear origin, or validity known, or standard instrument)?				
	4.4. Is there an acceptable response rate (60% or above)?				
5. Mixed methods	5.1. Is the mixed methods research design relevant to address the qualitative and quantitative research questions (or objectives), or the qualitative and quantitative aspects of the mixed methods question (or objective)?				
	5.2. Is the integration of qualitative and quantitative data (or results*) relevant to address the research question (objective)?				
	5.3. Is appropriate consideration given to the limitations associated with this integration, e.g., the divergence of qualitative and quantitative data (or results*) in a triangulation design?				
	Criteria for the qualitative component (1.1 to 1.4), and appropriate criteria for the quantitative component (2.1 to 2.4, or 3.1 to 3.4, or 4.1 to 4.4), must be also applied.				

*These two items are not considered as double-barreled items since in mixed methods research, (1) there may be research questions (quantitative research) or research objectives (qualitative research), and (2) data may be integrated, and/or qualitative findings and quantitative results can be integrated.

A3: strategy used for literature review (in no particular order)

Database searched	Search term Used	Number of papers found	Number of papers for review
ARCOM	"ageing" or "aging"	19	3
ScienceDirect	"construction worker"	143,124	34
PubMed	"Older construction worker"	21	19
ScienceDirect	"musculoskeletal" "construction"	4,179	9
Google Scholar	"health" "wellbeing" "construction"	1,280,000	11
Google Scholar	"early retirement" "construction"	446,000	10
ARCOM	"Ill health"	7	0
ScienceDirect	"participatory" "construction"	10,389	2
ScienceDirect	"knowledge transfer" "construction"	138,906	3

A4: key words used for searching relevant literature

Key words	
Ageing	Aging
Older worker*	Construction
Construction worker*	Construction industry
Health	Wellbeing
Disease*	Musculoskeletal
Work ability	Older construction worker*
Trades' worker	Electrician
Plasterer	Plumber
Bricklayer	Carpenter/Joiner
Retirement	Early retirement
Disability	Dermatitis
Noise induce hearing loss	Respiratory disorders
Toolbox talks	Construction apprenticeships
Knowledge transfer	Workplace design
Job design	Construction environment
Participatory ergonomics (in construction)	Ill health
Idea sharing / generation (in construction)	Campaigns (in construction)
Health and safety (in construction)	Interventions (in construction)

A5: critical analysis of papers researching older workers

Author(s)	Main aim	Design	Sample	Main findings	Critique (score)
Wickrama et al., 2013	To examine influences between work status and health outcomes including immediate memory, physical disability and depressive symptoms.	Longitudinal. 10 years. 1998-2008.	8,524 respondents over the age of 62. 58% female, 42% male.	Age significantly and negatively influences work status and immediate memory. Working appears to protect against the deterioration of physical functioning. Lower levels of working adversely influence memory, physical disability and depressive symptoms.	Longitudinal study. Nationally representative sample. Large sample size. (****)
Crawford et al., 2010	To evaluate research on health, safety and health promotion needs of older workers by identifying age-related changes, whether older workers need support and successful workplace interventions.	Systematic review.	180 publications.	There are several age-related physical and psychological changes in workers which can be moderated by physical activity and various other lifestyle factors. Changes are specific to the individual. Reaction times slow. Adverse health outcomes associated with being an hourly paid employee	Relatively large sample of papers reviewed using reliable and valid method. Clear aim, clear sample. (****)
Rohwedder & Willis (2010)	To investigate whether retirement leads to cognitive decline.	Surveys.	Older persons in the US, England and 11 European countries. 50 or older.	Early retirement has a significant negative impact on the cognitive ability of people in their early 60s that is both important and causal. Retirement is associated with a reduction in memory score compared to those who continue working.	Sample size not clearly stated. Cross-sectional sample allowing comparison. (***)

A5 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Westerlund et al., (2010)	To determine if retirement is followed by a change in the risk of incident chronic diseases, depressive symptoms and fatigue.	Longitudinal analysis, repeated measures. Self-reported health problems.	French occupational cohort. 11,246 men 2,858 women.	Cumulative prevalence of self-reported respiratory disease, diabetes, coronary heart disease and stroke increased with age. There was no break in the trend around retirement. Retirement was associated with a decrease in physical and mental fatigue. Retirement was associated with a major decrease in depressive symptoms.	Repeated measures – high reliability. Longitudinal study – high validity. Clearly defined aim. Self-reported health problems – open to bias (****)
Dement et al., (2009)	To investigate mortality among construction and trade workers working in the Department of Energy in the US.	Longitudinal one year study using medical screening and questionnaire	8,976 former construction workers in the Department of Energy in the US.	Workers in this area were at a very high risk of combined cancers. 674 deaths occurred, overall mortality was slightly less than expected which indicated a “healthy worker effect”. Significantly excess mortality was observed for several cancers. There were elevated risks for cancer of the lungs, trachea and bronchus.	Medical analysis of participants providing reliable findings. Voluntary participation therefore recruiting a certain sample. (****)
Park & Reuter-Lorenz (2009)	To test the proposal that the behavioural and brain data can be best understood within the model of ‘the scaffolding theory of aging and cognition’ (STAC).	Review of previous literature and data in relation to new theory.	Very unclear sample. Review of previous literature with no real system.	Age-related cognitive declines may be best understood in terms of a range of mechanisms; speed, working memory, inhibition, cognitive control. These can be countered by engaging in cognitively stimulating tasks and exercise.	Aim not clear. Neither sample nor clear therefore difficult to ascertain validity of findings. (**)
Westerlund et al., (2009)	To investigate how self-perceived health is affected by work and retirement in older workers.	Self-rated health trajectories – longitudinal 14 years.	14,714 employees, 79% men from the French GAZEL cohort. Gas and electrical work.	Suboptimum health increased with age. The year before and the year after retirement, suboptimum health fell 5%. Health improved after retirement for men and women and was maintained for 7 years after retirement.	Longitudinal study provides results with high validity. Self-rated health, open to bias. No in-depth exploration of reasons for results. (****)

A5 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Alavinia & Burdorf (2008)	To determine the associations between different measures of health and labour market position across ten European countries.	Interviews and self-reported current economic status & health questionnaire.	11, 462 participants. 50-64 years old. 10 European countries.	42% of men were employed in Austria in comparison to 75% of men in Sweden. 22% of women were employed in Italy in comparison to 69% of women in Sweden. Among employed, 18% reported poor health compared to 37% in retirees.	Cross-sectional, no indication of sequence of events. Large sample, good generalizability. (****)
Desmette & Gaillard (2008)	To investigate relationship between perceived social identity as an “older worker” and attitudes towards early retirement and commitment to work.	Survey study using self-administered questionnaire	352 workers aged 50-59. French speakers in private organizations.	Individuals considering themselves “older workers” more likely to want to retire early. Early retirement intentions negatively associated with perceived health. Work domain more likely to be devalued when older workers perceived low intergroup permeability.	Well specified aim. Clear sample but cannot be generalised. Results do not infer causality. (***)
Hinterlong et al., (2007)	To examine the association between health and multiple role involvement. What dimension of engagement affects individual health.	Interviews and self-rated health questionnaire .	8 year longitudinal nationally representative panel study.1644 adults aged over 60 in the US. Mean age 70.4.	Engagement in paid employment drops significantly over time. Volunteering becomes more prevalent. Engagement has significant association with better self-rated health. Relationship between engagement and health is likely to be bi-directional.	Nationally representative sample. Relatively large sample. Self-rated results open to bias. (***)

A5 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Loretto & White (2006a)	To address gaps in knowledge and understanding of employers' attitudes and practices towards older workers in Scotland.	Focus groups.	40 representatives from companies from different sectors such as finance, education and manufacturing.	All employers indicated used of equal opportunities policies but practice revealed bias and discrimination. Older workers were positively biased in some jobs, having greater life experience, job expertise, contacts and a better temperament. They weren't harder to train but lacked confidence. Opposed to nightshifts, thought to be cheaper, performance decreased from age 50 onwards.	Sources of qualitative data are relevant to address research question. Analysis process is also relevant. (****)
Buxton et al., (2005)	To compare the health status of economically active 50- to 64 year olds with economically inactive former workers (early retirees).	2000 Psychiatric Morbidity Survey of Great Britain – Clinical interviews.	1,875 participants aged 50-64. Currently working, unemployed or economically inactive but had a paid job since 50.	Remaining in work appears to be good for health. 71.2% of men and 66.4% of women early retirees reported having a long-standing illness. 22.2% of early retired men have a common mental disorder compared to 8.2% of those still in work. Men who retired early were more likely to have generalised anxiety disorders and depressive disorders.	Clinical interviews, robust and valid method of data collection providing high reliability. Well defined aim. (*****)
Taylor & Walker (1994)	To ascertain the extent to which employers were orientating towards older people.	Postal questionnaire	304 questionnaires were returned from 500 employers.	Significant numbers of employers did not provide training past the age of 50. The main factor against employment of older workers is their lack of appropriate skills. Employers considered older workers to be less trainable than younger. Older workers were less likely to be promoted. Positives: loyalty, productivity, reliability. Negatives: cautiousness, new technology, flexibility and interaction with younger managers.	Quantitative – no chance for follow up of views and opinions. May not have been a representative sample. (***)

A6: critical analysis of papers researching healthy, safety and wellbeing in construction

Author(s)	Main aim	Design	Sample	Main findings	Critique (score)
Järvholm et al., (2014)	To investigate how physically demanding jobs influence occurrence of disability pensions.	Longitudinal study 1980-2008. Previous health examinations	325,549 Swedish construction workers, all male aged 15-65	Disability pension was strongly dependent on age. 44 cases in workers aged 20-29 compared to 29,193 cases in workers aged 60-64. Construction workers have a substantial loss of working life due to disability pension.	Longitudinal study of representative sample answering research question. (***)
Karkhanis & Joshi (2011)	Not clearly defined. No aim, objective or purpose clearly shown.	Case study.	75 year old woman, non-smoker.	Individual exposed to dust for 30 years. No history of exposure to biomass fuel or passive smoking. Presented with a history of cough and breathlessness on exertion for 20 years. Had been hospitalized with respiratory failure.	High validity, in-depth review of individual. One participant cannot generalize. No clearly defined aim. (**)
Dement et al., (2010)	Explore airways obstruction among construction workers.	Medical screening program and detailed work and exposure history.	7,579 current and former workers at the Department of Energy nuclear weapons facility.	Workers with COPD significantly older and worked for longer. Prevalence of respiratory symptoms was significantly higher in workers with COPD. Administrative workers were much less likely to suffer with COPD (6.7%) compared to cement workers, plasterers and brick masons (24%).	High reliability and validity. Findings compared with general population. Relevant and large sample (****)

A6 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Hoonakker & van Duivenbooden (2010)	Examine whether older construction workers are at risk and specific risk factors for them.	Repeated cross-sectional questionnaire. 2 yearly health check-up.	Unclear. Over 53,000 blue collar workers.	Older construction workers have fewer complaints about physically demanding work but more about working in awkward postures. Older workers have significantly fewer injuries than younger workers both at work and during leisure time. Absenteeism in older workers is significantly lower than in younger workers however older workers have more complaints about their health.	Repeated design with very high reliability and validity. Clearly stated aims. Appropriate sample, method and analysis. (*****)
Cook et al., (2009)	Identify key health issues affecting older construction workers.	Triangulated approach – literature review, health professional consultation, worker interviews.	Struggled to gain access to workers so used general population. Sample was not clearly defined.	A number of health problems were discussed within the findings – these are summarised in Table 4.In the future there will be a real need for understanding and accommodating the older worker in construction.	Sample was not representative to answer research questions. Struggled to gain sample so used wider population. Non generalizable (**)

A7: critical analysis of papers researching injuries in construction

Author(s)	Main aim	Design	Sample	Main findings	Critique (score)
Schoenfisch et al., (2010)	*Not clearly stated.* To identify construction related injuries and illnesses using employment information in case records.	Calculation of injury rates were derived from current population survey estimates.	NEISS-Work data 1998-2005. 67 US A&E departments Estimated 3,216900 construction-related injuries.	Construction injuries increased from 10% in 1998 to 13% in 2005 of total A&E work-related injuries. Median age of workers was 37 rates of injuries were highest among younger workers and declined with age. Causes were contact with an object of equipment (54%), bodily reaction/exertion (19%) and falls (17%).	Representative sample. Large data set increases validity. (***)
Chau et al., (2004)	To assess the relationship of jobs, age, training, smoking, etc. with various causes and severity of occupation injuries.	Questionnaire which was validated by an occupational physician.	880 male construction workers North-East France 5 or more years' experience At least one occupational accident.	Injuries were mainly due to the handling or carrying of objects, falls, construction machinery and devices. Lesions concerned the upper and lower limbs and were often severe. Injuries from hand tools were more frequent in younger workers. Injuries caused by the handling/carrying of objects were less frequent in overweight workers. Injuries requiring hospitalization were less represented in younger workers.	Methods could have been altered to answer research question better for causality. (****)
Everett (1999)	To describe overexertion injuries in construction and present an ergonomic analysis of construction tasks.	Analysis of common building construction activities HTA with additional risk factor scale for each task.	65 of the most common tasks were analysed.	Many of the analysed tasks were rated as having a moderate or high risk factor that meant that the tasks were likely to cause fatigue and/or injury in some workers. It was found that posture stresses are far more significant than repetitive exertions which were unexpected. Static exertions, forceful exertions and local mechanical stresses were also important.	Minimal scoring system which does not fully answer research question. (***)

A7 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Gyi et al., (1999)	To assess the current issues for effective health and safety monitoring in the construction industry.	Case study investigation. Document analysis and semi-structured interviews.	Experienced managers. 9 construction companies.	'Unfamiliarity with the demands of the job', 'poor supervision' and 'no feedback from the system' were ranked the highest cause of accidents . The blame was not focussed solely on the worker. Reasons for non-reporting of incidents included the 'macho culture', fear of retribution and not wanting to contribute to a poor safety culture. 7 out of 9 companies used pre-employment medicals for their employees.	Well defined aim. Sample was appropriate and of a good size for the study. Analysis was appropriate and in-depth. (*****)
Jeong (1998)	To investigate the patterns of occupational deaths and injuries in terms of size of company, age of injured person, work experience, accident type, injury type, injured part of body and agency of accident.	Analysis of national statistics.	3028 deaths and 125,929 non-fatal injuries in the construction industry of Koreas over the 4 year study period.	Small companies with under 10 employees have a non-fatal injury rate about three times and a death rate about two times of those with over 1,000 employees. The highest number of injuries was seen in workers aged 45 and older. Falls from height were the most common type of accident (19.2%) followed by awkward/sudden movement (16.7%) and falls from height were the leading cause of death (42%)	Representative sample. Method used means extraneous factors are unknown. (***)
Falconer & Hoel (1996)	To investigate shapers of management perceptions in relation to their responsibilities in managing occupational safety and health.	Mixed methods. Document analysis, and qualitative methods. In-depth semi-structured interviews.	Random sample of 20% of injury reports reviewed. Interviews with 63 managers.	There was an emphasis on operator failure being cited as a major contributor to accident causation. 75% of managers cited carelessness and complacency as the major cause of accidents. 25% of first responses acknowledged the impact of work systems within the organization.	Qualitative methods allows for in-depth, rich data collection. Representative sample. Clearly stated aims. Appropriate data collection and analysis techniques. (****)

A7 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Stubbs & Nicholson (1979)	To re-examine accident data to identify the age and occupational groups at high risk.	Quantitative analysis and review of accident reports	821 accident reports from two large building and construction companies across 1976.	16-30 year olds suffer from the greatest number of accidents. An abnormally high accident risk was found for workers aged 16-18 and 19-21. Heavy trades had a significantly greater accident rate than light trades. 50% of manual handling accidents were caused by lifting/loading or lifting/carrying and were also responsible for 73% back injuries.	Large sample, relevant for the study. Study design was appropriate for the analysis of accidents. Aim was moderately clear. (***)

A8: critical analysis of papers researching musculoskeletal disorders in construction

Author(s)	Main aim	Design	Sample	Main findings	Critique (score)
Boschman et al., (2012)	To provide a more in-depth view of musculoskeletal disorders among two construction occupations.	Baseline and follow up questionnaires – one year follow up.	Baseline: 267 bricklayers and 232 supervisors. Follow up: 222 bricklayers and 177 supervisors.	At baseline 67% bricklayers reported 1 or more long lasting complaint. 3 body areas with the highest number of complaints were back, knee and shoulder/upper arm. At follow up more than half of the shoulder/upper arm , knee/upper leg, neck and back complaints were recurrent .	Low response from postal questionnaires. Questions the representation of sample. (****)
Widanarko et al., (2011)	To report the prevalence of MSDs in relation to gender, age and occupation amongst New Zealand employees.	Questionnaire. NMQ.	Random sample of 3003 men and women aged 20-64. New Zealand electoral role.	Low back had the highest prevalence followed by neck and shoulders. Lowest prevalence was for elbows. There were no significant differences related to age. MSD prevalence was highest among agriculture and fishery and elementary workers for males and legislator and administration workers for females.	Representative sample. Self-reported MSDs, could present bias. Relevant method. Clearly defined aims. (****)
Williams et al., (2011)	To investigate and understand the impacts of work environment and equipment design on working populations.	Questionnaire survey.	Three construction companies. 96 analysed questionnaires.	People viewed older age as being a negative barrier to work ability. 12.5% respondents performed sitting, standing and heavy lifting frequently. 45% of people described working “outdoors/no shelter”. People who work in construction are prone to experiencing musculoskeletal symptoms, which some respondents felt were a direct result of their work.	Large sample. Q’airre limited data lacking depth. Appropriate method. Sample relevant to study. Aim slightly unclear. Low response rate (****)

A8 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Inaba & Mirbod (2010)	To evaluate the effect of moderate cold exposure on musculoskeletal symptoms.	Self-administered questionnaires.	120 male Japanese electricians. 74 were tested in Winter (average age 36) 83 tested in Summer (average age 34).	Percentages of workers who had at least one disease in the Winter were significantly higher than those in Summer. Prevalence rates of stiffness in the fingers, white finger, pain in the wrist, knee joint, abdominal pain, weakness of the stomach and intestines, dull head, cough and sputum were significantly higher in the Winter than in Summer.	Additional methods such as health examinations would have increased validity of findings . (***)
Cook et al., (2009)	To identify key health issues affecting older construction workers and to develop wearable devices which will simulate these health effects.	Triangulated approach – literature review, health professional consultation and workers' interviews.	Struggled to gain access to workers so used general population. Sample was not clearly defined.	A number of health problems were discussed within the findings – these are summarised in Table 4. In the future there will be a real need for understanding and accommodating the older worker in construction.	Sample was not representative to answer research questions. Struggled to gain sample so used wider population. Non generalizable (**)
Punchihewa & Gyi (2009)	To investigate potential worker involvement in a participatory process by evaluating their ability to identify risks and user requirements to help reduce MSDs.	Mixed methods. Semi-structured interviews & REBA.	22 workers in 3 case study areas. 6 line managers.	The majority of workers interviewed had already made changes to their work and intended to make changes. 80% of cleaners and 100% of joiners and plumbers reported at least one MSD. Joiners reported a higher prevalence in the hands and lower back. Plumbers reported problems in the neck, knees, lower back and wrists.	Clear research questions. Relevant design with in-depth collection methods. Consideration given to the limitations. (*****)

A8 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Leaviss et al., (2008a)	To examine the relationship between ageing and construction work. To understand the needs and abilities of older construction workers.	In-depth interviews and small focus groups.	55 participants. H&S managers, site managers, older workers and retired workers.	Older workers are valued by the industry but there's a trade-off between skills and fitness. Older workers want to stay in the industry despite the high risk of injury & ill health. Being directly employed was associated with a better working environment. When older workers leave there may be a skill shortage due to younger workers not having the same skills.	Relevant design. Appropriate sample. In-depth rich, valid data. Good sample size. Well defined aims. (*****)
Lemasters et al., (2006)	To compare the quality of life and physical health of retirees from the construction industry to that of retirees from more sedentary occupations.	Mailed health survey.	77 construction retirees, 174 non-construction retirees.	42.1% of construction retirees reported significantly poorer health in comparison to 12.9% of non-construction male and 14.3% of non-construction female retirees. Male construction retirees were almost 5 times more likely to report their health as being fair or poor. More construction male retirees reported that their physical health reduced the time they were able to spend on daily	Cannot extend findings. Large and appropriate sample. Survey does not allow for in-depth results. (***)
Albers et al., (2005)	To describe task specific work-related MSD risk. To describe ergonomic interventions & those requiring further evaluation.	Qualitative. Meetings similar to focus groups.	39 industry representatives.1 7 construction ergonomics researchers. 4 ergonomic consultants.	MSD risks when drilling holes and shooting fasteners for the upper extremities, neck, back, shoulders and knees. These are generated from high forces from tools, vibration and rotational and impact forces as well as physical exertion to hold and operate heavy tools.	Appropriate method although researchers reported time constraints limiting the amount of data collected. (****)

A8 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Deacon et al., (2005)	*Not clearly defined*. To investigate the health status of older construction workers.	Individual physical medical examinations and recording of occupational histories through interviews.	Building contractors in the Western Cape. 142 older construction workers mean age 48.	Majority of workers (94%) reported exposure to dust and noise during their entire working history 20% reported exposure to dust, noise, chemicals, paint, stress, fumes, asbestos and cement. 13% reported difficulties with ears. 30% reported eye problems 8% of these were on-going. Skin disorders increased linearly with age.	Aim not clearly stated. Small sample size. Findings not generalizable to other countries. (***)
Mirka et al., (2003)	To develop a set of ergonomic interventions for framing carpenters and to quantify the impact of these interventions.	Ergonomic assessments (CABS) & models to quantify stress.	22 residential framing carpentry subcontractors.	The use of a pneumatic wall lift showed dramatic reductions in peak spine compression. The use of a nail gun with handle extension had less effects, more care was needed when using this due to the need for greater accuracy. The vertical lumbar handling system resulted in significant reductions in peak spine loads.	Clearly defined research questions. Multiple methods of testing, high reliability and validity (****)
Rosecrance et al., (2002)	To determine the prevalence of carpal tunnel syndrome among apprentice construction workers.	Cross-sectional. Questionnaires.	1,142 apprentices.	Sheet metal workers had the highest incidence of carpal tunnel syndrome (9.2%). Body mass index, age and self-reports of working overhead were associated with prevalence of carpal tunnel syndrome. Many construction workers begin to develop carpal tunnel syndrome before or during their apprenticeship.	Self-reported therefore open to bias. Relevant methodology. Relevant sample. Clear research questions (****)

A8 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Reid et al., (2001)	To review the literature regarding musculoskeletal complaints among bricklayers, carpenters and plasterers. To carry out site visits to observe and discuss their work and how it affects MSD risk.	Mixed methods. Literature review & site visits.	Unclear.	Construction is a high risk industry for musculoskeletal disorders. There are currently no distinctions between MSDs and trades. Most of the literature is focussed on low back, upper limb and knee disorders. Bricklaying is a high risk task for MSD disorders. Literature on plastering is restricted to drylining. Commercial pressures on workers force them to work as quickly as possible, risking safety.	Clear research questions. Very unclear sample. Data collected addresses research question. Lack of detail about design. (***)
Latza et al., (2000)	To identify work related risk factors of future lower back pain in construction workers.	Mixed methods. Longitudinal. Two interviews and physical examination.	230 construction workers.	At follow-up 31% of workers reported developing lower back pain. 13 work tasks were associated with an increased risk including transport of material, loading material, scaffolding, concrete distribution and sawing wood.	Clear research questions. Integration of data is relevant to address research question. Relevant design and sample. (****)
de Zwart et al., (1999)	To identify age-related work and health issues among construction workers that could influence future preventative measures.	Questionnaire.	1881 young (16-30) workers and 1946 older (45-64) construction workers.	Health problems increase with advancing age, particularly musculoskeletal problems. The most prevalent musculoskeletal problem is found in the lower back which was also positively associated with the number of years in employment. There were also positive age associations with hearing complaints, respiratory problems, contact dermatitis and vibration threshold.	Design does not allow for further exploration of responses but is appropriate for research questions. (****)

A8 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
van der Molen (1998)	To reduce the physical workload on gypsum bricklayers by means of mechanization, task enlargement and working with lighter bricks.	Qualitative. Observations & task analysis.	Very unclear. Two on-site situations were observed.	The average working time was 446 minutes. Mean heart rate was 60% of max. HR. Arm elevations of 60° or more and back flexions of 15° or more were more frequent in comparison with other construction workers. Overload can develop if some or all of the tasks are too heavy.	Relevant method to answer the well-defined research aims. Observations may have produced bias. Sample unclear. (***)
Albers et al., (1997)	To increase apprentices' knowledge of work-related MSDs, to prepare them for risks and to motivate them to prevent MSDs.	Control trials. One group received training. One control group.	18 new apprentice carpenters in experimental group. 19 controls.	Members of the training group scored significantly higher than controls on quizzes about ergonomics awareness. Apprentices found the training highly useful and preferred participatory teaching methods over traditional classroom instruction, particularly the applied learning methods.	Good use of control group – high reliability. No clear description of randomization. Complete outcome data. (****)
Lipscomb et al., (1997)	To identify a historical cohort of union carpenters, their person hours at risk and the compensation claims they filed.	Mixed methods. Administrative records and claims analysed.	10,935 union carpenters aged 17 to 76.	The highest number of claims were for back sprains followed by sprains to the neck and back and sprains to the knee. Age was a non-significant risk factor for most body areas although those aged 30-44 had a significant increase in the rate of fractures of the foot and also had twice the amount of elbow sprains than those younger than 30 years old.	Research questions not clearly defined. Relevant sample. Methods answered the aims. (***)

A8 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Arndt et al., (1996)	To describe the health status of older construction workers and the occurrence of early retirement due to disability or mortality within a 5 year follow up.	Cross-sectional quantitative health study.	4,958 German construction workers.	Construction workers had a higher prevalence of hearing deficiencies, signs of obstructive lung disease, increased body mass index and musculoskeletal abnormalities. During the follow up 341 men had left the industry due to disability and 141 had died. Compared to white collar workers, construction workers showed a 3.5 to 8.4 fold increased rate of disability.	Well defined research question. Appropriate, large sample. Methods answered research questions well. High validity. (*****)
Cook et al., (1996)	To develop trade-specific musculoskeletal injury profiles as the basis for formulating and evaluating ergonomic interventions to reduce prevalence of these.	Mailed questionnaire.	39 non-retired bricklayers, average age 45, average of 21.8 years work experience .	Low back disorders were the most prevalent musculoskeletal disorder and were also reported to account for the most lost work time and most physician visits. Shoulder disorders were the second most frequently reported work-related problem area with the neck, hand and elbow having approx. equivalent prevalence rates.	Small but representative sample. Method involved closed questions. (***)
Ringen et al., (1995)	To outline some of the difficulties, extent and causes of the problems in construction worker safety and health and to list health policy and health care issues.	Review of construction worker safety and health.	Very unclear.	Safety and health problems are tied largely to the construction industry's organization and how the work is performed. Many hazardous exposures result from inadequacies in access to information, measurement technology and personal protective equipment. Potential solutions are in labour-management site safety and health planning and management.	No clear research question. No clear sample. Method not clearly stated. (**)

A8 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Johansson (1994)	To analyse the prevalences of self-reported, work-related and non-work related symptoms occurring in 9 anatomical regions.	Questionnaires	8 large metal industries in Sweden. 241 blue and 209 white collar workers (n=450).	The highest prevalence of musculoskeletal symptoms among blue collar workers was in the neck, shoulders and low back. 44% workers reported shoulder symptoms and 36% of these felt symptoms were solely related to their work. Blue collar workers had higher prevalences of musculoskeletal symptoms and work related symptoms in several areas of the body.	Self-reported symptoms no opportunity for supplementary qualitative responses. (***)
Cederqvist & Lindberg (1993)	To focus on certain important aspects of screwdriver use in occupational work situations, with an emphasis on force exertion and screwdriver use.	Review.	Unclear.	A decrease in external shoulder torque together with improved production can be achieved through improvements of posture by working from a moveable small lightweight platform, using lightweight screwdrivers, reducing push force requirements with different head screws and careful selection of screw type.	Well defined research aim. Unclear sample and method. (**)
Luttmann et al., (1991)	To determine the frequency and duration of work sequences and to analyse postures of bricklayers.	Mixed methods. Field study supplemented by lab investigations.	3 building sites. 3 bricklayers.	An inclined posture was adopted 75% of the time when working on low level walls which dropped with increasing wall height. Below a wall height of 100cm bricklayers hold the load in one hand and for 30% of the bricklaying time. They hold the load in both hands for about 13% of the total bricklaying time.	Slightly unclear aims. Mixed methods, high validity. Relevant sample. Sampling strategy unknown. (***)

A8 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Niskanen (1985)	To clarify differences between concrete reinforcement workers & painters in the frequency, causes and types of accidents and minor accidents affecting the musculoskeletal system.	Analysis of accident report forms.	96 reinforcement workers and 91 painters.	Minor accidents affecting the MS system were reported five times more frequently by the reinforcement workers. In reinforcement work, the back was injured in one third of cases, the upper limbs in one fifth of cases and the lower limbs in one third of cases. Most accidents occurred during moving, removing bars or pulling them out of storage or during lifting or carrying.	Small but appropriate sample. Qualitative data collection such as interviews would have provided richer data although analysis was appropriate for the data used. Clearly defined aim. (***)

A9: critical analysis of papers researching the older construction worker

Author(s)	Main aim	Design	Sample	Main findings	Critique (score)
Dement et al., (2010)	To explore the prevalence of airways obstruction among construction and trades workers and to explore COPD risk associated with exposures.	Medical screening program and detailed work and exposure history.	7,579 current and former workers at the Department of Energy nuclear weapons facility.	Workers with COPD were significantly older and had worked for longer on DOE signs. The prevalence of respiratory symptoms was significantly higher in workers with COPD. Administrative workers were much less likely to suffer with COPD (6.7%) compared to cement workers, plasterers and brick masons (24%).	Design has high reliability and validity. Findings were compared with general population to improve validity. Relevant sample for study. Large sample size. (****)
Hoonakker (2010)	To examine whether older construction workers are a special group at risk and whether there are specific risk factors for older construction workers.	Repeated cross-sectional design. Questionnaire. Longitudinal periodic health checks.	Over 50,000 construction workers. Exact sample not specified.	Complaints about working in awkward positions increase with age. Older workers do not have more complaints about the psychological demands than workers in other age categories. Back and neck complaints increase with age. Complaints about the upper and lower extremities increase with age as does having received medical treatment for muscle and joint complaints.	Exact sample not specified. Method and sampling procedure appropriate. High validity. (****)
Hoonakker & van Duivenbooden (2010)	To examine whether older workers (55 and over) in the construction industry are a special group at risk and whether there are specific risk factors.	Periodic occupational health survey. Examination and self-administered questionnaire.	1993-2003 53,500 blue collar and 9400 office workers. Follow up: 75,500 blue collar and 22,670 office workers.	Over the follow up period physical demands generally increased however they were lower for older workers. Back and neck complaints, complaints of the upper extremities, complaints of the lower extremities particularly the knees, all increase with age.	Longitudinal study with representative sample. Measures were varied and in-depth. (****)

A9 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Buckle et al., (2008)	To investigate the suitability of current work system designs for older workers.	Qualitative. Focus groups and interviews.	Older workers. Human resources and occ. health managers.	Older workers felt that they were being carried by younger workers. Workers felt that they could not afford to leave work before the age of 60. Some workers wanted to remain in work because they would feel bored at home. More knowledge is needed to understand the needs of older workers.	Clearly defined aims. Appropriate sample and method to answer the aim. (****)
Lemasters et al., (2006)	To compare the quality of life and physical health of retirees from the construction industry to that of retirees from more sedentary occupations.	Mailed health survey.	77 construction retirees, 174 non-construction retirees.	42.1% of construction retirees reported significantly poorer health in comparison to 12.9% of non-construction male and 14.3% of non-construction female retirees. Male construction retirees were almost 5 times more likely to report their health as being fair or poor. More construction male retirees reported that their physical health reduced the time they were able to spend on daily	Cannot extend findings. Large and appropriate sample. Survey does not allow for in-depth results. (****)
Arndt et al., (2005)	To establish a detailed pattern of the nature and extent of occupational disability among construction workers.	Occupational health exams.	14,474 male construction workers aged 25-64.	2247 men were granted disability pension, mean retirement age was 56.1 years. 761 men were granted an old age pension, mean age 63.4. Risk of disability strongly increased with age. Major reasons for occupational disability were musculoskeletal disorders, cardiovascular diseases, neoplasms and mental disorders.	Representative sample. Longitudinal. High validity. Clearly defined aims. (*****)

A9 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Deacon et al., (2005)	*Not clearly defined*. To investigate the health status of older construction workers.	Individual physical medical examinations and recording of occupational histories through interviews.	Building contractors in the Western Cape. 142 older construction workers mean age 48.	Majority of workers (94%) reported exposure to dust and noise during their entire working history 20% reported exposure to dust, noise, chemicals, paint, stress, fumes, asbestos and cement. 13% reported difficulties with ears. 30% reported eye problems 8% of these were on-going. Skin disorders increased linearly with age.	Aim not clearly stated. Small sample size. Findings not generalizable to other countries. (**)
Holmström & Engholm (2003)	To describe musculoskeletal disorders in relation to age and occupation with the industry.	Self-administered questionnaire	85,191 Swedish male construction workers, foremen and office workers.	Prevalence of MSDs among construction workers increased with age. Prevalence rate of low back disorders in young workers was 18% compared to 35.7% in workers aged 55-59. Prevalence of shoulder disorders increased linearly from 8.8% in the youngest age group to 41.1% in ages 55-59. The prevalence of hip disorders increased slowly with age in the younger groups but increased more sharply from the age group 45-49.	Very large, appropriate sample for study. Self-administered questionnaires yield limited results however these were supported by medical check-ups with occupational nurses. (****)
Everett (1999)	To present a summary of research to investigate 65 construction activities for the presence of risk factors for overexertion injuries.	Review of construction activities.	12 basic tasks.	Repetitive exertions are an important risk factor in construction work however posture stresses are far more significant. Static exertions, forceful exertions and local mechanical stresses also appear to be at least as important as repetitive motions.	Method unclear. Sample unclear. Aim well defined. (**)

A9 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Louhevaara (1999)	To quantify the physical work load of blue collar workers and to compare the work load factors between ageing (45+ workers) and younger workers.	Quantitative postural and perceived work-loads.	63 men. 41 construction workers & 22 vehicle inspectors.	During the construction work the number of poor work postures was greatest for the back region. The back was bent and/or twisted for an average 47% of the working hours. The differences were small in dynamic work load between the groups of ageing and young construction workers.	Clear research questions. Relevant, representative sample. Appropriate method to address the research question. (****)
Sawacha et al., (1999)	To correlate the operatives' background and attitude towards safety with their accident or non-accident records. To determine the group of factors that has the most effect on site	Interviews. Questionnaire. Review of safety performance.	120 questionnaires returned. 200 sent	Operatives aged between 16-20 were more subjected to accidents than others. Level of accidents tends to decline steadily after the age of 28. The operation and use of mechanical plant and equipment were found to be a major source of accidents on site.	Well defined aim. Sample unclear. Methods appropriate to answer research question. Good response rate. (***)
Peterson & Zwerling (1998)	To compare health outcomes of older male construction workers with their counterparts in other occupations.	Interviews.	Health and Retirement Study. Unclear number.	Older construction workers were 1.4 times more likely to have back problems and 1.3 times more likely to have foot/leg problems than other blue collar workers. Construction workers are more susceptible to musculoskeletal disorders, chronic lung disease and emotional/psychiatric disorders. Older construction workers were 1.7 times more likely to have been diagnosed with an emotional problem than other older blue collar workers.	Large, appropriate study. Longitudinal, high validity. Well defined aims. Good response rate. (*****)

A9 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Koningsveld & van der Molen (1997)	To give a brief overview of the building and construction industry and of what has been done in the field of ergonomics.	:Overview of the building and construction industry.	No specific sample due to the nature of the paper.	The construction industry is often compared to a travelling circus. Much of the work is done outside, cold weather and the wind may affect the musculoskeletal and respiratory systems. International comparisons between construction sites are difficult due to the variation in methods, materials, status and traditions.	Not a scientific paper so difficult to review, however provides interesting and relevant information about older construction workers. (**)
Arndt et al., (1996)	To describe the health status of older construction workers and the occurrence of early retirement due to disability or mortality.	Routine occupational health surveillance examinations One year follow up.	4,958 mean aged 40-64 working in South West Germany.	Compared with white collar workers construction workers showed higher crude prevalences for most investigated items. Over 60% carpenters reported hearing loss and all construction workers had higher prevalence of musculoskeletal disorders and skin disorders. During follow up 340 men retired due to disability causes of which were musculoskeletal and cardiovascular diseases.	Relevant sampling strategy. Longitudinal representative sample. (****)
Irvine et al., (1994)	To investigate the nature of dermatoses and to specifically try to identify workers with allergic contact dermatitis.	Longitudinal health examinations.	1,138 men working in underground tunnels.	332 men diagnosed as having occupational dermatitis. Workers showed initial reluctance to attend the medical centre, fearing loss of job. 150 cement burns were seen. Grout burns were seen more frequently in younger, less experienced workers.	High validity with the use of nurses. Relevant and appropriate methods and sample. (****)

A9 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Aghazadeh & Mital (1987)	To determine the frequency, severity and annual cost of hand tool related injuries. To identify problem areas with regard to accident type, nature of injury and characteristics of injured worker.	Mailed questionnaire.	50 US agencies contacted, 23 responded with valid information.	Handtool related injuries comprise about 9% of all work-related injuries.3.9% of amputations were due to hand tool injuries and 5.1% were due to power tools. Younger workers were injured more frequently than older workers. This was attributed to older workers having more experience, conservative behaviour and less demanding jobs. Older workers knew their limits and do not take unnecessary risks.	Poor response to survey. Difficult sample to gain data from. Questionable validity of study. Q'airre was mailed to agencies therefore sample may not be representative. (***)

A10: critical analysis of papers using a participatory approach

Author(s)	Main aim	Design	Sample	Main findings	Critique (score)
Guimarăes et al., (2014)	To use a participatory intervention to enhance the social, technical and work design sub-systems of a company.	Longitudinal multifactor intervention. Meetings with workers.	100 workers, ergonomic committee, managers and ergonomic team.	Using a participatory approach, machines were removed which removed noise but did not affect temperature or lighting. Workstations were improved which increased satisfaction with work postures. Many changes were made to improve workplace and quality of working life.	Aim was not very clear. Sample not clearly specified. Questionnaire could not assess satisfaction. (***)
Gyi et al., (2013)	To work with drivers and their managers to co-develop intervention activities to raise awareness of musculoskeletal health in drivers	Interviews, questionnaire	4 companies	All organisations developed a sense of ownership of interventions – change within companies was effected from first contact – raised issues within companies that would have otherwise gone unnoticed – interviews enabled drivers and managers to become involved in the process.	Sample was collected through personal contacts but was relevant. (****)
Hignett et al., (2005)	To show how participatory approaches have been in different industrial and occupational health settings & to outline descriptions of programmes.	Review	3 main sources of studies from various industries.	Participatory ergonomics has been used in a wide range of industries including construction, transport healthcare and military. Participatory ergonomics interventions can be successful however it is advised that the expertise of ergonomists is not underestimated.	Well defined method, high reliability and high validity. Clear research aims. (*****)

A10 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Hess et al., (2004)	To introduce an ergonomic intervention to reduce low back disorders, quantitatively assess exposure and apply a PE approach.	Quantitative evaluation of lumbar motion. Repeated measures.	10 concrete labourers.	After using the intervention of skid plates, flexion increased significantly however worker involvement lead to modifications which significantly reduced low back velocity, acceleration and moments which have been associated with decreased risk of lower back disorders.	Comparison of conditions, high validity. Relevant sample. Method answered research aims. (*****)
Moore & Garg (2003)	To evaluate the effectiveness of a corporate ergonomics program that used a participatory approach to solving musculoskeletal hazards.	Review of injury incidence rates.	Crude incidence rates – not clear.	There was a dramatic downward trend in lost-time incidence rates. The annual crude incidence rate increased by approximately one third after implementing the ergonomics program. This was thought to be as a result of employee training on the recognition and reporting of musculoskeletal conditions.	Sample was unclear. Non-experimental method. Aim clearly stated. (***)
Loisel et al., (2001)	To propose integrated interventions at both the worker level and the workplace	Meetings, observations etc. Naturalistic field study	31 workplaces 16 randomized to PE intervention 37 workers were randomized to the program	68% employer representatives & 54% injured workers reported the program has led to an increased awareness of back pain risk factors in the workplace – 226 ergonomic solutions were proposed – 60% were totally or partially implemented – this was highest in the healthcare and manufacturing sectors	Study already part of a randomized clinical trial so high validity and reliability. (***)

A10 continued

Author(s)	Main Aim	Design	Sample	Main Finding	Critique (score)
Vink et al., (1997)	To apply and evaluate a participatory ergonomics approach	Checklists to seek improvements steering groups observations and measurements	2 scaffold building companies	Scaffolders had issues with particular problems in the workplace and with their work tasks – interventions included maximum length of ladders, commissioner to clean scaffolding & development of a pallet truck – 53% said cleaning it was better 30% used electrical winch 60% judged they had enough influence most improvements were judged positively.	Small sample size but representative of study population In-depth and relevant measures used. (****)
Moir & Buccholz (1996)	To conduct exposure assessments and to develop, introduce and evaluate interventions.	Participatory approach using advisory groups.	No sample used.	The goal of participatory methods is to design ways in which the workers find expression so that interventions are more likely to be successful. For interventions to be successful, stakeholders from all levels of construction must be included.	Specific research questions of the paper unclear. No sample defined. No study. (**)
Wilson (1995a)	To improve a control room with participation from the operators	Direct observation, archive analysis, environmental survey, questionnaires and rating scales	5 male crane drivers 40-63 years of age	Seats were changed – footrests were bought in – control sets were changed but then reverted – lighting changes were made – drivers were fully involved – drivers and supervisors continued to address the ergonomics of their working environment in the absence of an ergonomist.	Very small sample size appropriate consideration given to the influence of findings. (*****)

A11: study one information sheet

Participant Number	

Building Healthy Construction Workers: Better by Workplace Design

Participant Information Sheet

Researcher:	Stephanie Eaves	S.Eaves@lboro.ac.uk	01509 223590
Supervisors:	Dr. Diane Gyi	D.E.Gyi@lboro.ac.uk	01509 223043
	Prof. Alistair Gibb	A.G.Gibb@lboro.ac.uk	01509 223097

What is the purpose of this study?
The construction industry is well known for being high risk and labour intensive. It does not always provide a comfortable environment for long-term or older workers, requiring them to do heavy manual work, sometimes in bad weather. We think the workplace can be designed to be more comfortable for workers, and that older, more experienced workers can help us to do this.

Who is doing this research and why?
This research will be carried out by myself, Stephanie Eaves. I am under the sponsorship of Loughborough University and Age UK.

Once I take part, can I change my mind?
Yes! After you have read this information and asked any questions you may have, I will ask you to sign an informed consent form.
If you wish to withdraw from the study at any time, all you have to do is say so. You can withdraw at any time, for any reason and you will not be asked to explain your reasons for withdrawing.

How long will it take?
Interview sessions will last between 30 minutes and 1 hour. Observations will last between 30 mins - 1 hour.

Is there anything I need to do before the sessions?
No, there is nothing you need to do before these sessions.

Is there anything I need to bring with me?
No, you do not need to bring anything with you.

What will I be asked to do?
I will be asking you some questions about your work, any aches and pains you may have experienced and how you think these can resolved. I am interested in any design ideas you may have, however complicated or simple. Things you may have done to make your job easier, or your workplace a better environment.

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Study one information sheet continued

Participant Number

What personal information will be required from me?
Your name will be required purely for the contact sheet, in the write up of this data you will be kept anonymous.

Are there any risks in participating?
There are no risks in participating in this study.

Will my taking part in this study be kept confidential?
When data is collected and throughout this research, your information will be kept anonymous. Your name will not be included and you will be identified by a number. The data will be kept in a safe and secure place at Loughborough University.

What will happen to the results of this study?
The results of the study will be used for my PhD thesis and also for publication.

I have some more questions, who should I contact?
For more information, please feel free to contact me, or my supervisors.

What if I am not happy with how the research was conducted?
Loughborough University has a policy to deal with this *"Research Misconduct and Whistle Blowing"* which is available online:
http://www.lboro.ac.uk/admin/committees/ethical/Whistleblowing(2).htm.

Thank you

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A12: study one informed consent form

Participant Number	

Building Healthy Construction Workers: Better by Workplace Design

Informed Consent Form
(To be completed after participant has read information sheet)

The purpose and details of this study have been explained to me. I understand that this study is designed to further scientific knowledge and that all procedures have been approved by the Loughborough University Ethics Approval (Human Participants) Sub-Committee.

I have read and understood the information sheet and this consent form.

I have had an opportunity to ask questions about my participation.

I understand that I am under no obligation to take part in the study.

I understand that I have the right to withdraw from this study at any stage for any reason, and that I will not be required to explain my reasons for withdrawing.

I understand that all the information I provide will be treated in strict confidence and will be kept anonymous and confidential to the researchers unless (under the statutory obligations of the agencies which the researchers are working with), it is judged that confidentiality will have to be breached for the safety of the participant or others.

I agree to have my photograph taken and/or have videos taken during observations during work on the site and understand that I will be kept anonymous by blurring of the face.

I agree to participate in this study.

Your name ______________________________

Your signature ______________________________

Signature of Investigator ______________________________

Date ______________________________

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A13: study one interview schedule

Thank you for taking the time to have this interview with me. My name's Steph and I'm a PhD student at Loughborough University, I am also being sponsored by Age UK. My research is investigating the design of the workplace in construction, and I'm hoping to talk to you and your colleagues about the type of work you do. I'll be asking you about your job, the work you do and anything you may have done in the past, or do now, to make your job healthier, easier or less painful/dangerous for you. Everything you say will be kept confidential, and the interview will be recorded for my research purposes.

1. **Demographics**
   sheet 1

I'm interested in the type of job that you do here on site and what's involved

2. **Job Details:**
   - What do you do in your job?
     Prompts
     - *Everyday tasks*
     - *Tools and equipment used*
     - *PPE required / used / worn*
     - *Is this PPE always worn? Why not?*
     - *Is this PPE altered? How? Why?*
     - *Inside / Outside?*
     - *Up high / low?*
     - *In cramped / awkward positions?*
     - *Using chemicals? Dust? Noise*
   - Job specific questions
     - *How do you cope with….*
     - ***Plasterers**: Weight of the trowel*
     - ***Electricians**: Lighting, smaller tools*
     - ***Bricklayers**: Weather, job rotation*
     - ***Carpenters**: Tools, cramped positions*

A lot of people make changes at work to make their jobs easier; these can be little changes like wearing knee pads, or putting their dust masks inside their hard hats to keep them clean, to changing the level of lighting around their workspace. They can also be changes to specifically protect parts of your body, such as wearing specific gloves to protect your hands, or changing the way you lift to protect your back.

I'd like to ask you some questions about the ideas you have to make your job easier, you don't have to be doing them right now, but you may have had some ideas, or know of other workers who do these things.

3. **Design at work:**
- What ideas do you have to make your job healthier / safer?

Study one interview schedule continued

- How about to make the workplace healthier / safer?
- Are there ways you have tried to make your job healthier or safer for your back/neck/arms etc?
    - *Different equipment*
    - *Flooring*
    - *Lighting*
    - *PPE*
    - *Talks / Workshops*
    - *Job Rotation*
    - *Micro breaks*
    - *Places to rest / sit*
    - *Changing rooms*
    - *If you had an endless supply of money, what changes would you make?*
        - *To the workplace*
        - *To the tools*
        - *To the equipment*
        - *To the timings*
- What advice would you give to a younger worker going into the same job as you are in now?
- What kind of ideas have you seen being put to use in the workplace?
- ***Older:*** You've been in this job a long time, how have you protected your back/arms/neck etc.?
- What would you do differently now if you could go back 5 / 10 / 20 years?
    - ***Younger:*** *how do you think you will be working in 5 / 10 / 20 years?*
- Who would implement these changes?
- What stops you from making these changes now?

4. **Knowledge and perception of risk within the workplace**
   sheet 2
   As I mentioned, a lot of people have already made changes in their job to make things easier, I'm now going to ask you some questions about your knowledge and perception of risk and how you feel about making changes in the work place to reduce your risk of injury or aches and pains.

5. **Health**
   sheet 3
   I'm now going to go through a couple of questionnaires with you – these will ask questions about any aches and pains you feel in your body and also about how you feel about your work

A14: Stage of Change questionnaire

Participant Number | |

As I mentioned, a lot of people have already made changes in their job to make things easier, I'm now going to ask you some questions about your knowledge and perception of risk and how you feel about making changes in the work place to reduce your risk of injury or aches and pains.

4. **Knowledge and Perception of risk within the workplace:**

1. Are you concerned about developing aches and pains or anything more serious (musculoskeletal problems) from your work?

1. ☐ Yes 2. ☐ No

2. Do you think changes should be made to reduce the risk of aches and pains (musculoskeletal problems) from your work in the next six months?

1. ☐ Yes 2. ☐ No

3. Do you think changes should be made in the next month or two?

1. ☐ Yes 2. ☐ No

4. Has **your employer** made any changes to reduce the risk of aches and pains (musculoskeletal problems) from your work?

1. ☐ Yes 2. ☐ No

5. Are **you** doing or **have you done** anything to reduce the risk?

1. ☐ Yes 2. ☐ No

- What kinds of things are you doing at the moment to make your job easier / less awkward?
  - *Using different equipment*
  - *Altering the equipment you already have*
  - *Doing jobs in a certain order*
  - *Wearing different things – knee pads, different gloves*

6. How long ago did you make these changes? ____________wks/mths/yrs

7. If more than 6 months ago do you intend to do anything more?
1. ☐ Yes 2. ☐ No. If yes please describe the changes

____
____
____

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A15: Nordic Musculoskeletal Questionnaire

Participant Number

Nordic Musculoskeletal Questionnaire

This is a short questionnaire which allows me to assess any musculoskeletal disorders you may have, or any aches and pains you are suffering with.
This questionnaire consists of a short series of questions to assess how bad the pain is that you may feel.

Please answer **all** the questions in the **first column**.
If **yes,** answer the questions in the other three columns for that body area.

Have you at any time in the **last 12 months** had symptoms (such as **ache, pain discomfort numbness or tingling**) in:	Have you had any symptoms in **the last 7 days**?	In your opinion, do you think these symptoms are directly **related to the work you do**?
Neck No ☐ Yes ☐	No ☐ Yes ☐	No ☐ Yes ☐
Shoulders No ☐ Yes ☐	No ☐ Yes ☐	No ☐ Yes ☐
Elbows No ☐ Yes ☐	No ☐ Yes ☐	No ☐ Yes ☐
Wrists/ Hands No ☐ Yes ☐	No ☐ Yes ☐	No ☐ Yes ☐
Middle back No ☐ Yes ☐	No ☐ Yes ☐	No ☐ Yes ☐
Lower back No ☐ Yes ☐	No ☐ Yes ☐	No ☐ Yes ☐
Hips, thighs or buttocks No ☐ Yes ☐	No ☐ Yes ☐	No ☐ Yes ☐
Knees No ☐ Yes ☐	No ☐ Yes ☐	No ☐ Yes ☐
Ankles or feet No ☐ Yes ☐	No ☐ Yes ☐	No ☐ Yes ☐

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A16: Work Ability Index

Participant Number

1. Are the demands of your work primarily;

◯ Mental ◯ Physical ◯ Both mental and physical

2. Current work ability compared with the lifetime best

Assume that your work ability at its best has a value of 10 points. Please circle the points you would give your current work ability (0 means that you cannot currently work at all).

	Completely unable to work 0	1	2	3	4	5	6	7	8	9	work ability at its best 10
Current Workability	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

3. Work ability in relation to the demands of the job

How do you rate your current work ability with respect to the physical demands of your work?

◯ Very good ◯ Rather good ◯ Moderate ◯ Rather poor ◯ Very poor

4. Work ability in relation to the demands of the job

How do you rate your current work ability with respect to the mental demands of your work?

◯ Very good ◯ Rather good ◯ Moderate ◯ Rather poor ◯ Very poor

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A17: study two information sheet

Participant Information Sheet

Researcher:	Stephanie Eaves	S.Eaves@lboro.ac.uk	01509 223590
Supervisors:	Dr. Diane Gyi	D.E.Gyi@lboro.ac.uk	01509 223043
	Prof. Alistair Gibb	A.G.Gibb@lboro.ac.uk	01509 223097

What is the purpose of this study?

We are experiencing an ageing workforce and in industries such as construction, retaining older, experienced workers can be difficult. This study looks to investigate the ideas, opportunities and barriers of retaining and encouraging older workers to remain healthy and comfortable in their workplace for longer. We want to encourage worker participation in the industry so that the knowledge and experience of construction workers is not wasted.

Who is doing this research and why?

This research will be carried out by myself, Stephanie Eaves. I am under the sponsorship of Loughborough University and Age UK.

Once I take part, can I change my mind?

Yes! After you have read this information and asked any questions you may have, I will ask you to sign an informed consent form.

If you wish to withdraw from the study at any time, all you have to do is say so. You can withdraw at any time, for any reason and you will not be asked to explain your reasons for withdrawing.

How long will it take?

The focus group sessions will last from 1 to 1 and a half hours.

Is there anything I need to do before the session?

No, there is nothing you need to do before this session.

Is there anything I need to bring with me?

No, you do not need to bring anything with you.

What will I be asked to do?

I will be asking you about your ideas and opinions of older workers and any thoughts you have on retaining them in the workforce. I am interested in any ideas you have to encourage your employees to think about their health and well-being, and ways in

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Study two information sheet continued

which you can keep them involved in decisions about change. I will be asking you to put your ideas forward in a number of different ways, both individually and through group discussions.

What personal information will be required from me?
Your name will be required purely for the contact sheet, in the write up of this data you will be kept anonymous.

Are there any risks in participating?
There are no risks in participating in this study.

Will my taking part in this study be kept confidential?
When data is collected and throughout this research, your information will be kept anonymous. Your name will not be included and you will be identified by a number. The data will be kept in a safe and secure place at Loughborough University.

What will happen to the results of this study?
The results of the study will be used for my PhD thesis and also for publication.

I have some more questions, who should I contact?
For more information, please feel free to contact me, or my supervisors.

What if I am not happy with how the research was conducted?
Loughborough University has a policy to deal with this *"Research Misconduct and Whistle Blowing"* which is available online:
http://www.lboro.ac.uk/admin/committees/ethical/Whistleblowing(2).htm.

Thank you

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A18: study two informed consent sheet

Informed Consent Form

(To be completed after participant has read information sheet)

The purpose and details of this study have been explained to me. I understand that this study is designed to further scientific knowledge and that all procedures have been approved by the Loughborough University Ethics Approval (Human Participants) Sub-Committee.

I have read and understood the information sheet and this consent form.

I have had an opportunity to ask questions about my participation.

I understand that I am under no obligation to take part in the study.

I understand that I have the right to withdraw from this study at any stage for any reason, and that I will not be required to explain my reasons for withdrawing.

I understand that all the information I provide will be treated in strict confidence and will be kept anonymous and confidential to the researchers unless (under the statutory obligations of the agencies which the researchers are working with), it is judged that confidentiality will have to be breached for the safety of the participant or others.

I agree to participate in this study.

Your name ________________________________

Your signature ________________________________

Signature of Investigator ________________________________

Date ________________________________

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A19: study three information sheet

Building Your Healthy Construction Worker

Participant Information Sheet

Researcher:	Stephanie Eaves	S.Eaves@lboro.ac.uk	01509 223590
Supervisors:	Dr. Diane Gyi	D.E.Gyi@lboro.ac.uk	01509 223043
	Prof. Alistair Gibb	A.G.Gibb@lboro.ac.uk	01509 223097

What is the purpose of this study?

We are experiencing an ageing workforce and in industries such as construction, retaining older, experienced workers can be difficult. The event this afternoon is to feedback the findings of the research you have been involved in and to explore your opinions and ideas to co-develop an impact resource to encourage healthy ageing in construction. We want to encourage worker participation in the industry so that the knowledge and experience of construction workers is not wasted.

Who is doing this research and why?

This research will be carried out by myself, Stephanie Eaves. I am under the sponsorship of Loughborough University and Age UK.

Once I take part, can I change my mind?

Yes! After you have read this information and asked any questions you may have, I will ask you to sign an informed consent form.

If you wish to withdraw from the study at any time, all you have to do is say so. You can withdraw at any time, for any reason and you will not be asked to explain your reasons for withdrawing.

How long will it take?

This event will take place this afternoon from 1pm – 4pm

Is there anything I need to do before the session?

No, there is nothing you need to do before this session.

Is there anything I need to bring with me?

No, you do not need to bring anything with you.

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Study three information sheet continued

What will I be asked to do?
I will ask you for your ideas and opinions on a number of topics, such as older workers and ageing in the construction industry. I will be asking for your thoughts on the types of interventions that would be successful in the industry to encourage healthy ageing.

What personal information will be required from me?
Your name will be required purely for the contact sheet, in the write up of this data you will be kept anonymous.

Are there any risks in participating?
There are no risks in participating in this study.

Will my taking part in this study be kept confidential?
When data is collected and throughout this research, your information will be kept anonymous. Your name will not be included and you will be identified by a number. The data will be kept in a safe and secure place at Loughborough University.

What will happen to the results of this study?
The results of the study will be used for my PhD thesis and also for publication.

I have some more questions, who should I contact?
For more information, please feel free to contact me, or my supervisors.

What if I am not happy with how the research was conducted?
Loughborough University has a policy to deal with this *"Research Misconduct and Whistle Blowing"* which is available online:
http://www.lboro.ac.uk/admin/committees/ethical/Whistleblowing(2).htm.

Thank you

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A20: study three informed consent form

Informed Consent Form
(To be completed after participant has read information sheet)

The purpose and details of this study have been explained to me. I understand that this study is designed to further scientific knowledge and that all procedures have been approved by the Loughborough University Ethics Approval (Human Participants) Sub-Committee.

I have read and understood the information sheet and this consent form.

I have had an opportunity to ask questions about my participation.

I understand that I am under no obligation to take part in the study.

I understand that I have the right to withdraw from this study at any stage for any reason, and that I will not be required to explain my reasons for withdrawing.

I understand that all the information I provide will be treated in strict confidence and will be kept anonymous and confidential to the researchers unless (under the statutory obligations of the agencies which the researchers are working with), it is judged that confidentiality will have to be breached for the safety of the participant or others.

I agree to participate in this study.

Your name ______________________________

Your signature ______________________________

Signature of Investigator ______________________________

Date ______________________________

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A21: end of session questionnaire

Dissemination Event Questionnaire

Name ....

Age range Under 25 ☐ 25-34 ☐ 35-49 ☐ 50+ ☐

Occupation ....

Company ....

Time spent in construction (years) ....

Are you concerned about an ageing workforce? Please provide details

How do you think engagement of the workforce could be encouraged? (eg. Idea capture, discussions, knowledge transfer etc.)

End of session questionnaire continued

What do you think should be included within the guidance document for the construction industry? How can this resource have maximum impact?

If you could speak to the Government and MPs about older workers in construction, what would you say to them?

Any further comments

Thank you for attending today's session

A22: end of session checking sheet

Workshop 'Checking' Sheet

What were the salient points from this workshop?

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Were there any unexpected findings?

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Is there anything that needs to change in the next workshop?

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Further comments

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A23: version one of impact resource

Industry briefing document: building healthy construction workers to facilitate healthy ageing

Steph Eaves, Diane Gyi & Alistair Gibb – 2016

Globally there is an ageing population which means an increasingly older workforce. Construction is a male dominated industry, notorious for early retirement due to injury and ill health because of the tough, heavy, manual nature of the work.

Workers are commonly required to perform repetitive tasks in awkward and cramped positions and in all weathers. . Indeed, construction workers of all ages in our study[1] reported aches and pains, particularly in the knees, lower back, wrists and hands - those aged 50 and over reported more symptoms。

In addition, gender differences in attitudes to health may have an impact on health promoting behaviours: males generally exhibit more risky behaviour, have a 'macho' attitude to work and are less likely to engage.

Despite this, the workers involved in this research had many good ideas on healthy ageing at work, were keen to share them and wanted to remain in work[1]. Managers in the construction companies were also keen to listen and consider how suggestions could be implemented in the workplace[2].

Our research explored improving health and wellbeing in the construction industry to facilitate healthy ageing and longer working lives. This document presents the main messages.

Who is it for?

Supervisors and managers of construction trades' workers who are interested in health and wellbeing at work may be interested in this project. Supervisors are essential to this process due to their frequent and consistent contact with the workforce.

How to use it

Hundreds of ideas were suggested by workers focussing on ways of making their jobs and workplaces healthier, safer and more comfortable. These ideas can feed into discussion as part of inductions, briefing sessions, courses and toolbox talks.

Trades' workers and managers expressed the need for more interaction, communication and regular feedback discussions within the workforce.

Listening and taking advantage of such ideas from the workforce is worthwhile – a sense of ownership has been shown to significantly increase buy-in.

Engaging with workers

The majority of workers are keen to put forward their ideas and suggestions and to share tips for healthier working. To build trust within the workforce, these should be considered with appropriate and timely feedback given. This will help encourage further engagement and reassurance that they are being listened to. One project manager suggested a "you said - we did" policy to reassure workers that their suggestions are being taken seriously.

A noticeboard is an effective way to display health interventions such as competitions and campaigns. It could also be used for workers to share ideas and suggestions for healthier working. Suggestion cards could be pinned to the noticeboard with replies being posted underneath. The cards could be reviewed during toolbox talks to ensure workers feel valued and that their ideas are being considered.

Toolbox talks are an important opportunity to have a group of workers together, discussing specific ideas for improvements to health and wellbeing in the workplace. Workers themselves could present the toolbox talks, or provide a tick sheet of potential subjects for future toolbox talks and ask for a vote. Workers will feel more invested in the talks if they feel they have 'had a say' about content.

Finally, it is important that workers do not feel that communication is 'just to tick a box'. Suggestions include 'asking' workers what they would like to learn about, who they would like talks from, regularly updating talks/information to keep it interesting and making sure that workers feel valued.

Resources

There are many different ways to encourage interaction and engagement of the workforce. Workers want interesting and 'hard hitting' tool box talks, ideally with videos, props and examples of equipment/tools as well as presentations. Some suggestions to increase the interactivity of learning sessions:

- Researchers at Loughborough University have developed online tools to help workers of all ages think about healthy working, ergonomics and workplace design. Organiser for Working Late (OWL) includes a number of '@ work' cards to encourage discussion with 'talking points' about health and wellbeing at work (www.workinglate-owl.org).
- Encouraging interaction and engagement with the workforce doesn't have to be expensive. Simulating eye injuries and visual disorders by using damaged glasses or goggles encourages discussion around the importance of wearing eye protection. Asking workers to tape coins to their knuckles and attempt tasks such as using a screwdriver can simulate limited hand function. Another simple suggestion is to ask workers to tuck their thumbs into their palms and try to tie shoe laces or put on a jacket to simulate the loss of a digit
- Wearable simulations which mimic the effects of common health problems experienced by construction workers have been created by researchers at Loughborough University. Dermatitis gloves (pictured) can be used for discussion around the importance of wearing gloves and using barrier hand creams both at work and outside of the work environment (http://www.healthandsafetyatwork.com/hsw/ppe/second-skin).

What workers suggested

Ideas from workers themselves are presented around the improving job and workplace design towards longer, healthier working lives. There is no judgement as to their suitability in practice – rather they can be 'discussion points' and form the basis of open communication with workers on site.

Musculoskeletal symptoms

Workers wanted more sharing of practical ideas to reduce aches and pains:

For workers – 'before you start':

- Take care to plan a lifting task
- Rotate tasks with colleagues – work together
- Make sure your workbench is at the right height for you
- Use assistive tools and machinery to help with heavy loads
- Personalise your PPE to make it right for you

For workers – 'doing the task:

- Think about your body!
- Make yourself as comfortable as possible if in awkward positions for long periods of time
- Think about supporting your back when working on the floor
- Take regular 'breathers'
- Work at a calm sensible pace to save your body

For supervisors and managers:

- Listen to and ask the advice from experienced workers, they are keen to help
- Rotate tasks between co-workers

Health

Workers argued strongly for more 'healthy' related changes in the workplace:

Key experts visiting sites:

- Dentist and medical vans
- Physiotherapist
- Charities to talk about health issues such as skin cancer

Health outside work:

- Stress the importance of looking after health outside of work; recreational sports, attending the gym, pilates classes etc.
- Exercise, diet and weight loss, stop smoking and stop drinking campaigns

Training:

- Health-related toolbox talks; noise-induced hearing loss, dermatitis, vibration white finger, effects of being overweight at work, diabetes etc.

Health at work:

- Healthier food choices in canteens
- Health checks such as blood pressure and diabetes
- Barrier creams for hands and skin readily available

Facilities

Workers felt that facilities on construction sites could be improved and were deemed essential to the wellbeing of workers.

Easy to do:

- Better provision of toilet rolls

- Regular checks on toilet facilities

Needing more investment or effort:

- Improved welfare facilities e.g. bigger, more spacious and cleaner changing rooms
- Showers on site where possible
- Better provision of hot water on sites
- Fresh drinking water readily available on site
- A wider range of healthy food choices in canteens
- Parking at a closer proximity to sites

Workspaces

Workers were keen to improve their workplaces to maintain a good level of health at work.

Things that should just be done anyway:

- Make sure areas are clean and tidy
- Dampen work areas to remove dust

Things that need pre-planning:

- Where possible, provide ventilation such as extractor fans
- Think about ways to reduce slip hazards

PPE

Workers experienced difficulties with the quality and design of PPE in particular situations:

Good ideas whatever the situation:

- Consult the workforce on provisions of PPE with transparent discussions on budget
- Allow workers to 'top up' PPE budget and buy better quality boots, gloves etc.
- Provide full face dust masks to prevent goggles steaming up
- Provide adequate clothing and good 'rain gear' for bad weather
- Encourage workers to cover their backs

Ideas that need discussion as they may create other risks[1]:

- Allow goggles to be taken off in wet weather
- Allow fingers to be cut from gloves when doing very intricate tasks

Human Resources

There was concern about the lack of younger workers coming into the industry and that knowledge and experience were not being passed on:

- Create more opportunities for apprenticeships on sites
- 'Pairing up' younger and older workers to facilitate knowledge transfer
- Better supervision of younger workers on site

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References

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[1] It is acknowledged that some of these actions proposed by workers may increase the risk of injury or ill-health from the task – However, the reality is that workers ARE making these workarounds and therefore it would be unwise to ignore them. It also emphasises that PPE should be the last resort and other approaches should be employed wherever possible.