

## CONSTRUCTION WORKERS' PERCEPTION AND USE OF ASSISTIVE DEVICES IN REGARDS TO MUSCULOSKELETAL DETERIORATION: A QUALITATIVE STUDY

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### ABSTRACT

*Background:* Workers in the construction industry are faced with a high degree of occupational hazards, one being physical wear and tear. Yet this phenomenon remains largely unexplored as there is a lack of both scientific terminological consistency, and of the actual specified numbers of cases with lost working ability. This results in an unspecific field of musculoskeletal deterioration (MD) and unclear possibilities for identifying the effects of countermeasures, such as the use of assistive devices (AD).

*Objective:* The aim of this paper is to examine construction workers' understanding of occupational MD and AD, and their use of AD as countermeasures to MD.

*Method:* Semi-structured interviews with road/bridge construction workers and work-alone carpenters are carried out to gain knowledge about workers' understanding of accidents and MD, as well as their use of AD and personal protective equipment.

*Results:* The constructions workers generally do not perceive the use of AD as obvious countermeasures to MD. As opposed to accidents and injuries, MD is generally perceived as an inevitable part of the occupational activity.

*Conclusions:* The presence, planning, instruction, motivation for and correct use of AD are vital for actual counteractions of MD and need to be aligned with realistic production and safety goals. Educational measures are needed to promote managers' and workers' knowledge of the benefits of using AD to prevent MD. Furthermore, there is a need for extended inquiry into the phenomenon of MD and possible interventions to unveil the dynamics behind the lack of knowledge and use of AD. Proactive educational measures which show feasible ways of preventing MD are needed.

**Keywords:** Physical deterioration, occupational injuries, technical aids, personal protective equipment, leadership "walk the talk" congruence, participative inquiry.

# 1. INTRODUCTION

## 1.1 Socio-economic and personal impacts of musculoskeletal deterioration

Based on increased longevity, the aging of the large post-war birth cohort born around 1950 and the subsequent smaller cohorts, it is predicted that the elderly proportion of populations will increase during the following decades in post-industrialized countries (An & Jeon, 2006; Edmonston, 2006).

In such a demographic prospect that leaves construction workers as one of the last occupational groups working under highly physically strained conditions, the amount of such workers that end up with reduced working ability, being long term absent or exiting the work-market prematurely, can be seen as a potential further challenge, which accrues to the general stressed socio-economic condition. One plausible cause for such lost or reduced working ability is occupational musculoskeletal deterioration (MD), which is defined here as accumulated musculoskeletal wear and tear. From the socio-economic to the personal level of those paying the highest price, these aspects unveil the highly negative impact of MD, and accentuate the importance of preventive measures in occupational functions in general, and in the construction industry in particular.

## 1.2 Musculoskeletal deterioration: an important yet problematic academic issue

The construction industry is one of the most hazardous in terms of safety issues (Larsson & Field, 2002; Mohamed et al., 2009; Niza et al., 2008; Snashall, 2005). The linkage of the industry to the phenomenon of MD suggested here is based on the following findings. Hagen et al. (2002) demonstrated that physical work played a crucial role for later disability retirement in the general working population, and Eriksen and colleagues (1998) concluded that musculoskeletal pain, especially in the lower back, related highly with the risk for long-term work disability in their samples of working people. In a sample from the Danish Work Environment Cohort Study, Christensen et al. (2006) found that between 10 % and 30 % of long-term sickness could be referred to as dependent on the physical working environment. Based on data from construction of the Great Belt Link in Denmark, Hannerz et al. (2005) demonstrated that construction workers there had a pronounced risk of disability retirement, and Tüchsen and colleagues (2005) concluded that “building and construction work is associated with excess risks of diseases of the musculoskeletal system and connective tissue...” (ibid., p. 26). Based on this, it can be plausibly argued that MD relates to disability retirement, as MD potentially results in reduced or lost working ability and, following the physical strain, that a high level of MD amongst construction workers is plausible.

Yet the scientific inquiry into occupational MD seems to lack a consistent terminology approach. This is demonstrated by the use of various terms ranging from physical deterioration (Holtermann et al., 2010), muscular-skeletal disorder (Devereux et al., 2002), to Lipscomb and colleagues' (2004) “physically taxing nature” (ibid., p. 417) of the working environment, or the related question of potential symptoms of MD, such as chronic muscular pain (Meeus et al., 2007). These various labels and terms further accrue to the lack of clarification of MD, as they might include phenomenon such as acute injuries – which are not due to long-term wear and tear. The consequence of this lack of terminological consistency is threefold; 1) the actual phenomena covered by these various terms and symptoms is unclear, 2) the number of occupationally related cases of musculoskeletal wear and tear is not known, and 3) the exact proportion of reported cases out of the total number of disability retirements has not yet been studied.

To gain knowledge about the phenomenon of MD, and to recommend ways of intervention, further clarifications in the field are necessary. Being loyal to this demand, and at the same time accepting a lack of solid scientific ground, this study preliminarily defines MD as accumulated physical wear and tear, resulting in lost or reduced working ability. Occupational physical injuries are often operationalized as lost-time-injury rates (Coleman & Kerkerling, 2007; Harper et al., 1971) that require some form of medical treatment, hospitalization, physical restitution and/or work absence. Injuries become a question of physical severity and rehabilitation, a definition that takes into account more severe injuries. In this paper, the definition of MD includes all injuries, from the ultimate loss or near-death, to minor injuries, such as cuts and bruises; that is, continually occurring damage, not only of major-character, but minor damage as well. The sum of this accumulated musculoskeletal wear and tear makes up the level of MD. This state of wear and tear then leads to lost or reduced work ability.

## 1.3 Preventive means at work place

Seeking out preventive measures for MD is an obvious task of occupational safety research. Assistive devices (AD) (van Kyuk-Minis, 1998; Maitra et al., 2010) can be defined as supportive aids designed and used not only according to efficiency goals, but also as effectiveness goals in regards to preventing or reducing MD. For the definition of AD utilized here, the common denominator, besides mere functionality, is that their correct usage aims at reducing or eradicating strenuous or repetitive movements, hereby hindering long-term accumulation of

repetitive wear and tear. Defining AD, Biermans and colleagues' (2004) broadly inclusive definition of technical aids as products "ranging from injection needles to wheel chairs" (ibid, p. 107), is relevant as a base for the definition of AD used here. Narrowing down the range to the point of interest in the field of building and construction, AD-products are items such as ladders, scaffolding, tools, wheelbarrows, lifts, and cranes. Contrasting AD, personal protective equipment (PPE) is meant for preventing or reducing the effects of unforeseen incidents, hereby preventing acute injuries or reducing their severity (Cavazza & Serpe, 2009). PPE include helmets, safety shoes, safety belts for working in heights, security-gloves, protective glasses and reflective vests, just to mention a few.

The terms AD and PPE can become ambiguous due to the abovementioned lack of consistency in terminology, and for some, their practical use as both AD and PPE. This reflects the qualitative variation in injuries they are designed to prevent, either long-term or acute damage. Ear protection is an example of a product that reduces acute injury (then functionally PPE) and long-term hearing disability (then having the function of AD). This problem of relating AD to MD is further depicted, in that general scientific literature on AD, defined as preventive measures for MD in the construction industry, is scarce. Hence AD is a somewhat blurred concept much alike MD. For clarity in regards to the term AD as it is used here, it is understood as supportive aids, which designs and correct usage contribute to the reduction or eradication of MD.

## **2. OBJECTIVE OF CURRENT CASE STUDY**

The background for this paper is an interim evaluation of an intervention research project directed towards construction workers' perception of, attitude towards and actual use of AD as a countermeasure for MD. For this evaluation we sought to explore to what degree construction workers relate, cognitively and in practice, AD to preventive measures for MD, leading to the following open research questions: What perceptions do construction workers have of musculoskeletal deterioration and assistive devices?, and, to what degree do construction workers relate, cognitively and in practice, assistive devices to preventive measures for musculoskeletal deterioration?

## **3. METHOD**

### **3.1 Introduction**

An intervention project entitled "Working environment at eye level" aimed at reducing MD through construction workers' use of AD, is being conducted by the Danish Technological Institute. Three privately owned firms voluntarily participate in the project, all active in the field of construction, building and/or maintenance of physical structures. The professions found in the three firms range from carpenters, bricklayers, crane operators and mechanics to construction labourers (soil/earth and concrete workers). Some of the construction labourers have no formal professional education in their field. The study serves as the basis for the case studies in this paper, providing a summary of an interim effect-evaluation. During the research process it was decided to probe for workers' perceptions and usage of MD and AD, with semi-structured interviews, in order to gain in-depth data. Interviews were carried out in two of the three participating firms, a choice due to the proximal distance to their working sites and centres of business activity. Construction workers in firm 1 work interdependently in groups, and firm 2 consist of highly mobile independent carpenters, who carry out work mainly from their vans.

### **3.2 Qualitative method**

One of the strengths of qualitative methods, such as semi-structured interviews, is that they allow for the exploration of unclear concepts (Corbin & Strauss, 2008). In this nascent state of scientific understanding of MD, another strength of qualitative methods becomes relevant, namely the fact that it invites participants to actively engage in and contribute to the phenomenon under scrutiny (Howitt, 2010). In-depth accounts given by participants are thus seen as valid sources of data. Accounts are here understood as subjective interpretations of incidents (Orbuch, 1997) in regard to construction workers' perceptions and use of AD as countermeasures for MD. It is with these presented strengths that the decision to carry out semi-structured interviews was taken, thus providing in-depth data about construction workers' cognitive representations of MD and actual usage of AD.

### **3.3 Population and procedure**

The analyses in this paper are based on semi-structured interviews carried out with the two sub-groups of workers in the spring of 2010. Workers were asked to participate under the terms of anonymity and voluntary participation. The workers in firm 1 were asked by their supervisor if they would like to participate. Eleven decided to do so. We do not know precisely how many were asked and declined, as the numbers of workers at the

specific site varied from day to day. However, the drop-out rate is at the most 50 %. In firm 2, permission to contact the workers was granted by the workers' supervisor, and they could be contacted directly by phone and asked if they wanted to participate. Five of the eight contacted decided to participate, two decided not to participate and one was not reachable. Workers, who had agreed to participate, were given a short presentation of the project and the interim evaluation on the intervention with AD on MD. Workers were interviewed by the primary author, on site (firm 1), at their various work locations or at the firm's administrative centre (firm 2).

### 3.4.1 Interviews

The semi-structured interviews covered five themes: 1) perception and use of AD, 2) perception of the term MD (Danish term '*nedslidning*', which literally means wear and tear), 3) perception of the term accident (Danish term '*ulykke*', which literally means unlucky incident, often with the connotation of unexpectedness), as we wanted to see if there was a clear distinction between long-term and acute injuries, 4) safety culture, as it was expected that the occupational group setting would influence their perceptions and actual usage of AD, and 5) safety management, as it was expected that management's approach to occupational safety was crucial for the quality of safety culture. The interview-guide consisted of ten questions, each containing sub-questions needed for further exploration (Appendix I). All interviews were recorded on a digital dictaphone, and were transferred to, transcribed and coded in QSR NVIVO-8. Coding followed the five interview themes described above.

### 3.4.2 A note on management

Safety management seemed an important theme to cover in the interviews, as there is evidence of successful application of management factors in safety interventions. Safety management (Zohar & Luria, 2003; Zohar & Tenne-Gazit, 2008), and safety-climate (Zohar, 2008; Zohar, 2010) can be seen as top-down approaches to safety, in contrast to safety-culture, which is sometimes seen as a bottom-up approach to safety (Choudhry et al., 2007; Walker, 2010). Safety climate has expanded as a primary and important focus of safety research in recent years. Organizational safety-climate is defined by Zohar and Luria (2003) as "socially construed and shared representation of those aspects of organizational environment that inform role behaviour, that is, the extent to which any facets of role behaviour are rewarded and supported in any organization." (ibid., p. 322). With this, management forms the epicentre for the safety-climate, due to its potential for reward and support of certain behaviours relevant for occupational safety. The two firms focused on in this paper presumably have a rather high level of safety climate since their management decided to volunteer in the safety intervention research, thus making supervisor practice on safety issues a prioritized task (Zohar, 2004).

## 4. RESULTS

### 4.1 Construction workers' perception of assistive devices and personal protective equipment

In contrast to the project definitions of AD and PPE, we found that workers often, when asked about AD, either did not differentiate between AD and PPE at all, or perceived them as very similar, e.g.:

*Well, we have these assistive devices... or uh personal protective equipment... I know there is a slight difference between them...* (Extract one: firm 2, int.5).

And another comment, when asked about examples of AD:

*...you wear the belt [safety harness, PPE]... and of course things like protection-glasses [PPE]...* (Extract two: firm 1, int.2).

There is a negative difference due to the fact that the workers tend to think about PPE when asked about AD, and they often use them interchangeably, as shown above.

### 4.2 Construction workers' perception of musculoskeletal deterioration

On the other hand, the workers made clearer specifications of MD, e.g.:

*Musculoskeletal deterioration, it's... it's... it's work in general... well, so, uh, so work in general is of course wear and tear over time...* (Extract three: firm 1, int.10)

Another comment when asked about how to define MD:

*Musculoskeletal deterioration is for example to work outdoors in the wind and cold... sore muscles and sometimes hard work, and it's wearing down, there's a natural wear and tear somehow...* (Extract four: firm 1, int.7)

MD is generally seen as caused by long-term wear and tear, due to the work functions, and is generally considered an inevitable part of the job as a construction worker. The construction workers' perception of what MD is, aligns to the definition presented in this paper.

#### **4.3 Construction workers' perception of 'accidents'**

Contrasting MD is the phenomenon of 'accidents'. When asked if accidents can be prevented, the following replies were representative for the majority of the participants:

*There're two things in it [preventing 'accidents'], but they are obviously together ... business ... time pressure ... yes; it can be a very serious cause! If you do not clean up, for example, because there just isn't time to clean up...* (Extract five: firm 2, int.5)

Another worker's voice:

*After all, you can of course [prevent 'accidents'], but again it is with the routine as you go and become sloppy,... there is of course planning... it is also a part of it, and use of personal protective equipment ...* (Extract six: firm 1, int.9)

And further:

*Gee... it's definitely planning [for preventing 'accidents']... you can also train people to use the material they get ... yes, have the employee that is needed exactly there...* (Extract seven: firm 1, int.6)

'Accidents' are viewed as being caused by various more controllable elements, such as inattention, lack of skills and lack of PPE-use, as well as poor work planning. Thus 'accidents' are seen as more preventable, since these factors can be potentially counteracted.

#### **4.4 Construction workers' perceptions of the relation between musculoskeletal deterioration and assistive devices**

When asked specifically about how to prevent or reduce MD, responses from many workers show that AD are perceived as playing a rather small role, e.g.:

*You can reduce the risk of it [MD] to some extent, to a large degree you can reduce it in the form of assistive devices, e.g. a crane, loader tractor, truck or whatever other means you may have, but I do not believe that you can totally prevent it* (Extract eight: firm 1, int.5)

And another comment:

*There is a wear, and it is true that if we are 67 years old and we cannot walk anymore, then we are worn out... But uh ... I have the impression that the possibility, when we work here, that we wear and tear [MD] - but we do not necessarily get worn out, it lies much within the individual...* (Extract nine: firm 2, int.1)

What is seen here can be interpreted as a lack of a clear relation amongst the implied construction workers' view on AD and its proposed use in preventing or reducing MD. When there is a relation, MD is still surrounded by a fatalistic attitude, making AD a tailor-made potent counter-measure less obvious to construction workers.

## **5. DISCUSSION**

### **5.1 General data**

When the construction workers were asked about their use of AD, the qualitative data shows generally positive responses. It was found though, that workers have troubles distinguishing AD from PPE, blurring the validity of the answers on the question on actual usage of AD. One way to explain the blurred differentiation between AD and PPE could possibly be that the interview contains all four major topics; AD, PPE, 'accidents'

and MD, and therefore a priming effect might be considered. This is reasonably a potential bias-factor for the qualitative data upon AD.

Attention should also be given to the question of a possible Hawthorne effect (Landsberger, 1958; Roethlisberger & Dickson, 1939) in the workers' responses, as social interaction and attention could bias the responses positively. Workers were forward with their responses, and no reasons were found as to why this bluntness should shroud an even stronger critique of actual conditions, colleagues or management, that is: being a moderation of how workers look upon management and/or safety matters in their respective firms. However, no attempts were made to counteract any possible Hawthorne effects on the interim evaluation, besides the anonymity of the respondents, the voluntary participation and the quite specific questions exploring into and allowing for honest critique.

## **5.2 Construction workers' perception of assistive devices and musculoskeletal deterioration**

Unspecified perceptions of AD were discovered amongst workers, which are of utmost importance to the study, and to the knowledge about workers' views on AD. Firstly, the study found a lack of a clear distinction between AD and PPE. Secondly, an overall perception of MD as different from accidents was demonstrated, in that MD is perceived as an inevitable part of the job. These perceptions seem to support each other, in that AD is not clearly distinct and MD is not preventable. Interestingly, workers' perceptions showed a close relationship between 'accidents' and PPE, more or less leaving MD as unpreventable, and to a lesser degree leaving AD (as a group of preventive tools directed at MD) out of the question. The replies about workers' perceived relationship between AD and MD, showing a negative difference, can however be interpreted as rather ambiguous due to the suggested priming effect when asked about several issues, which clearly was not very distinct to the participating workers. One plausible explanation might be that the workers hold a severity-graduated perception of general MD, resulting in several types of bodily damage due to their variation in preventability, as it was seen in the inquiries into MD and 'accidents'.

## **5.3 Safety-climate**

Accepting that safety-climate (Zohar, 1980) has grown to an important field within safety research (Fernández-Muñiz et al., 2007; Zohar, 2010) the question of the effect of safety management is of interest. The sample from firm 1 as a larger centralized group of workers, working a long time together on different projects, and supervised by the same person, could be higher on safety-climate, since there is daily contact between workers and supervisors. Thus the contact to the supervisor is more pronounced. The sample from firm 2 consisted of smaller, decentralized, highly mobile service units, lacking a single supervisor figure. In this latter case there is less influence between managers and workers. Safety climate issues are therefore likely at play in the data, and the two firms plausibly differentiate on these issues. However, we did not find supportive evidence for this in our qualitative data, thus it remains speculation. As this paper contributes to the interim evaluation of the large intervention project, it is important to consider these possible differentiations, and their possible effect on the intervention regarding use of TA as a preventive tool for MD.

## **5.4 Management words and deeds congruency**

Another management-related field of interest was workers' perceptions of management's words and deeds congruency (Simons, 2002) regarding general safety. This is often referred to as 'walk the talk'. Management deeds are the actual act, here regarding occupational safety. Management words, on the other hand, are here seen as the communicative level of safety climate; that is: how managers act rhetorically regarding safety on a daily basis. It seems that the workers in the study, at times, perceived a lack of congruency between the words and deeds of their managers, resulting in a detrimental effect upon workers' intrinsic safety motivation, as the following two cases show:

When a worker objected to carry out work on a site that was improperly secured, he was replaced on the particular task. Asked about how that affected his view on management's safety talk he replied as follow:

*One laughs a little at their [management] expense ... their intentions are good, but it is not always that they are being put into practice. (Extract ten: firm and interview known to researchers)*

He then reported that he would at times engage aggressively in legal matters of safety regulations, and use it as meticulously as possible, arguing against managers' plans, and to use his argumentation to bind with his co-workers. This strategy could be seen as a defiant action, tending towards a rather aggressive coping style of the worker based on the perceived word and deed incongruence, which makes the actual safety norms secondary compared to the safety conflict between managers and workers.

Another worker, when asked how he would react, when management lacked congruency between word and deed, answered quite similarly. The case was that some scaffolding parts were not up to regulation standards, and he was asked to carry out some work at the site:

*I build it without taking into consideration all those regulations, because the scaffold is illegal anyway!* (Extract eleven: firm and interview known to researchers)

He continued bluntly, when asked how he perceived management safety rhetoric that is not followed with consistent acting:

*I can't take it [safety talk] seriously!* (Extract twelve: firm and interview known to researchers)

This worker reported that he would find himself with a low degree of intrinsic motivation for working carefully, and sometimes choose not to follow regulations or try to work safe, as it was not a sincere approach from the management that they should work safely. His reaction towards management word and deed incongruence would be deficient on his own in-situ safety standards. It seems that a perceived lack of managers' word and deed congruency can lead to de-motivation or cynicism and internal hostility amongst workers. A result of this is a lower safety standard.

## 5.5 Scientific implications of the study

The data suggest that a perceptual difference exists between the uses of PPE as a preventive tool for accidents, contrasting a lack of an equal perception of AD as a preventive tool for MD. Classical accidental incidents, largely resulting in acute injury, and MD, a long-term accumulated injury, were defined as two different things: accidents referred to as immediate damage, requiring some sort of medical aid and potentially prevented by usage of, in particular, PPE, whereas MD was viewed in a fatalistic optic. This shows that the project's (leaders' and researchers') perception of AD and the preventability of MD differed from the construction workers' perceptions: a fact that could have a tremendous effect upon previous and future qualitative and quantitative research alike. It seems that data are blurred and could be regarded as potentially low in validity, and in the view of this it remains unclear as to what the responses actually refer to. Implications for intervention studies could be that data are to be reconsidered, and the specific distinction between MD and AD, as well as the obvious relation between them, should be revised both in quantitative and qualitative approaches.

The following aspects of AD-usage as a countermeasure to MD are considered important for further studies to take into account. The importance of AD as preventive tools for MD lies not only in obvious aspects, such as their actual *presence*, or the willingness amongst supervisors, foremen and managers to provide them if they are not present, but also in their actual *usage* amongst workers. This notion on use involves educational and motivational aspects; workers may not use AD even though management have provided and demanded they be used. Supposing that motivation to use AD is existent, it raises the question of planned use. Temporal and spatial barriers to their usage, such as time pressure and limited working space both hinder actual use of AD. In addition, some AD are not a one-size/type-fits-all, and therefore may have to be adapted to the user, task and working conditions. Planning can be viewed as a responsibility of double provenience: leaders and workers should organize work in such ways as to allow for temporal and spatial use of AD. Besides these motivational and planning issues regarding the use of AD, there is at least one other decisive factor in preventing MD, namely the *correct* usage of them. If planning provides time for instruction, then the risk of malign use of AD is arguably diminished. AD used improperly or having sub-optimal design, risk contributing to the accumulated wear and tear of users. Therefore, the successful preventive effect of AD-use regarding MD requires the presence, planning instruction, motivation (realistic production and safety goals) and correct use of AD.

## 5.6 Future research

Walsh et al. (2008) states that generally one in four adults are faced with musculoskeletal pain, and further argued that it is the most common source of long-term pain and physical disability. Hence, musculoskeletal pain can be a potential symptom of MD. Chronic musculoskeletal pain is proposed to be widespread, but the close relationship between possible contributing factors remains largely unspecified (Marras et al., 2009; McBeth & Jones, 2007). Even when the causal factors are referred to, they often lack closer specification, adding to the conceptual obscuration of MD. This testifies to the need for improved knowledge about MD. We hope that constructive critique of the definition of MD will arise as a way of improving conceptual clarity in the field.

We would also like to point out the intriguing question of causality in regards to MD; if the many accumulated injuries and strains provide a higher risk of MD, then how does the condition of individuals having MD affect the possibility of single case acute injury, e.g. back injury? As the single injury, within our perspective,

accumulates to the level of MD, is the long-term accumulated injury then at the same time making the individual more prone to (further) single injuries, and if so, to what degree? A very promising point of study which has not found nearly the attention we think it deserves.

## **6. CONCLUSION**

Regarding the three research questions forming the base for our inquiry, we conclude the following: As for the first research question asking what perceptions construction workers have of musculoskeletal deterioration (MD), we conclude that the construction workers in the sample generally see MD as a fatalistic phenomenon, difficult if not impossible to prevent. This is in contrast to perceptions of 'accidents', which are predominantly seen as preventable. For the second question regarding what perceptions construction workers have of assistive devices (AD), we conclude that the construction workers in the sample generally had trouble distinguishing between AD and personal protective equipment (PPE), often perceiving AD as a type of PPE. Finally, as our open research questions attempted to explore to what degree construction workers relate, cognitively and in practice, AD to preventive measures for MD, we conclude that the sampled workers' perception of AD as specific countermeasures for MD is weak or non-existing.

Due to the fact that the construction workers generally see MD as an inevitable part of the job, and furthermore have troubles distinguishing AD as tailor-made preventive tools, no strong evidence was found for motivational factors for the workers' usage of AD as a way of preventing MD. Incongruence in regards to management safety words and deeds could plausibly be one determining factor for construction workers' use of AD.

Elaborating further on motivational issues of the use of AD in regards to MD, the presence, instruction, correct usage and planning, both on behalf of managers and workers, are vital. Managers should ensure that AD are accessible, that workers are instructed in the practical use of AD and that it is possible, in temporal and spatial terms, for workers to use them. Managers and workers need to coordinate work within and between construction trades, so that they have the necessary AD ready for use when they are needed, and that they are used in the proper ways. Last but not least, intrinsic (health benefits) and external (social, monetary etc.) motivations, aligned with realistic production and safety goals, are crucial for the actual usage of AD. Only then will AD become effective countermeasures for MD.

## **7. IMPACT ON INDUSTRY**

Educational measures are needed to promote managers' and workers' knowledge of the benefits of using AD to prevent MD. Effective MD prevention requires the presence, planning, instruction, motivation for and correct use of AD. Intrinsic and external motivations for the regular use of AD to counteract MD need to be aligned with realistic production and safety goals, and it is crucial that workers perceive that management 'walk the talk'.

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## **Appendix I**

### **INTERVIEWGUIDE - Semi-structured interviews**

Underlined numbering – question always asked. Other questions only asked directly if not otherwise brought up during the interview.

#### **1. Occupational safety**

1.1 *What comes to your mind when you hear the words ‘occupational safety’?*

1.2 *Can you give an example where matters of safety were dealt with in a positive way?*

1.3 *Can you give an example where matters of safety were dealt with poorly?*

#### **2. Assistive devices and musculoskeletal deterioration**

2.1 *What comes to your mind when you hear the words ‘assistive devices’ in terms of occupational safety?*

2.2 *What influence do you have on your level of occupational safety?*

2.3 *Do you use assistive devices, to protect you at work?*

2.4 *Can you describe a situation where assistive devices increased the level of safety?*

2.5 *Can you give an example where the use of assistive devices meant that security was dealt with poorly?*

2.6 *Can you describe a situation where you lacked assistive devices?*

2.7 *What is occupational ‘attrition’ (Danish: nedslidning, translating most directly into wear and tear or deterioration) for you?*

2.8 *Is it possible to avoid / prevent attrition?*

#### **3. Accidents, health hazards and safety**

3.1 *What comes to your mind when you hear the word ‘accident’ (Danish: ulykke)?*

3.2 *When is something an accident?*

3.3 *Can you name anything that can contribute to accidents’ occurring?*

3.4 *Is it possible to prevent accidents?*

3.5 *How do you react to uncertainty and possibilities for occupational hazards to your health?*

3.6 *Can you give an example of such a reaction?*

3.7 *Who will you turn to, if you have questions about occupational safety matters?*

#### **4. Safety climate, personal protective equipment**

4.1 *Who do you consider to be your immediate supervisor?*

4.2 *How do you perceive managements’ concerns about safety, assistive devices and personal protective equipment?*

4.3 *Can you give an example of this?*

4.4 *Can managers do anything to make your job safer?*

4.5 *Can you give an example?*

#### **5. Summary**

5.1 *How do you feel about the issues we have talked about?*

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