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The ageing workforce: implications for occupational safety and health

A research review

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Abbreviations and acronyms

Anact	Agence nationale pour l'amélioration des conditions de travail
BAuA	German Federal Institute for Occupational Safety and Health
CIPD	Chartered Institute of Personnel and Development
EU	European Union
EU-OSHA	European Agency for Safety and Health at Work
Eurofound	European Foundation for the Improvement of Living and Working Conditions
ENWHP	European Network for Workplace Health Promotion
EWCS	European Working Conditions Survey
GDP	gross domestic product
GP	general practitioner
HR	human resources
HSE	Health and Safety Executive
ISSA	International Social Security Association
MSD	musculoskeletal disorder
NIOSH	National Institute of Occupational Safety and Health
NHS	National Health Service
OSH	occupational safety and health
OiRA	Online interactive Risk Assessment
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SME	small and medium-sized enterprise
SOC	selective optimisation with compensation
TAEN	The Age and Employment Network
TNO	Netherlands Organisation for Applied Scientific Research
TUC	Trade Union Congress
UFOV	useful field of view
WAI	Work Ability Index
WHO	World Health Organization
WHP	Workplace Health Promotion

Executive summary

This review has been carried out as part of a larger project of the European Agency for Safety and Health at Work (EU-OSHA), initiated by the European Parliament. The project, 'Safer and Healthier Work at Any Age', aims to enhance the implementation of existing recommendations; the exchange of best practice; and the further investigation of possible ways of improving occupational safety and health (OSH) in order to improve the sustainability of work. It supports the objective of the EU Strategic Framework on Health and Safety at Work 2014-2020 to address ageing in the workforce, and provides an overview of the key issues related to OSH, but is not a comprehensive review.

- **Background — why be concerned about ageing and sustainable work?**

The proportion of older people in the general population is increasing across the EU. Even more importantly, this ageing of the general population is mirrored by the ageing of the working population, reflecting, in parallel with demographic trends, a number of socio-economic developments. For instance, there has been a push at the European level to increase the employment rate of those aged 55-64 years. Furthermore, many Member States have increased the official pension age to more than 65 for both men and women, and many Member States are planning to increase the retirement age even further. These changes are motivated by concerns regarding meeting state pension costs. An older working population, an increase in the number of years worked and continuing to work at an older age have implications for OSH and sustainable work.

However, economic measures, such as increasing the official pension age, will be successful only if workers are able to work and retain their physical and mental health into retirement. This requires, among others, measures to improve occupational health.

In particular, increasing the pension age has two possible implications for occupational risk prevention and the sustainability of work. Firstly, many occupational diseases and the effects of demanding work develop over time from cumulative exposure; therefore, extending the number of years worked may extend the exposure to hazards and increase the risks of developing occupational diseases or having one's physical ability affected by demanding work. Secondly, the work ability of those aged over 65 years and their continued ability to work in physically or mentally arduous working conditions in particular must be considered. For both of these implications of working for longer, the importance of reducing the exposure to hazards and making work easy for all workers is clear. In 2010, of those aged 50-54 years, 33.7 % did not think that they would be able to do the same job at 60 years of age. However, this overall average masks important differences between sub-groups of the working population: both men and women in low-skilled jobs, which are likely to be more physical in nature, have considerably greater concerns than men and women in professional and managerial jobs (Eurofound, 2012b).

The ageing of the working population, combined with increases in official pension ages to more than 65 years, means that more employees are likely to develop chronic health problems while still at work, as the prevalence of chronic health problems increases with age. Some of these chronic health problems will have a work-related component. However, regardless of whether work contributes to a chronic health problem or not, policies to promote working for longer and to reduce the incidence of early exit from the workforce need to focus on helping those with chronic diseases function actively at work (Eurofound, 2014).

In order for workers to stay in work as they age, attention must be paid to creating good-quality working conditions, with an appropriate work–life balance, employment security and lifelong learning opportunities throughout the working life (Eurofound, 2012a). This is what is meant by 'sustainable work'.

- **Focus of the review**

Creating sustainable working conditions requires a wider understanding and appreciation of the influence of any age-related changes in work capabilities or susceptibilities and the cumulative impact of exposure to risks throughout the working life. This review has collated evidence on the current situation in relation to the challenges of an ageing workforce for OSH. The review examined the following three questions:

- 'What changes occur in ageing individuals within the workforce, and what are the likely impacts of work along the life course on health and ability?'

- 'What are the implications of these changes and the impacts of work along the life course in relation to OSH and sustainable work?'
- 'What OSH measures can be considered to mitigate any potentially adverse safety and health effects and to promote sustainable work along the life course?'

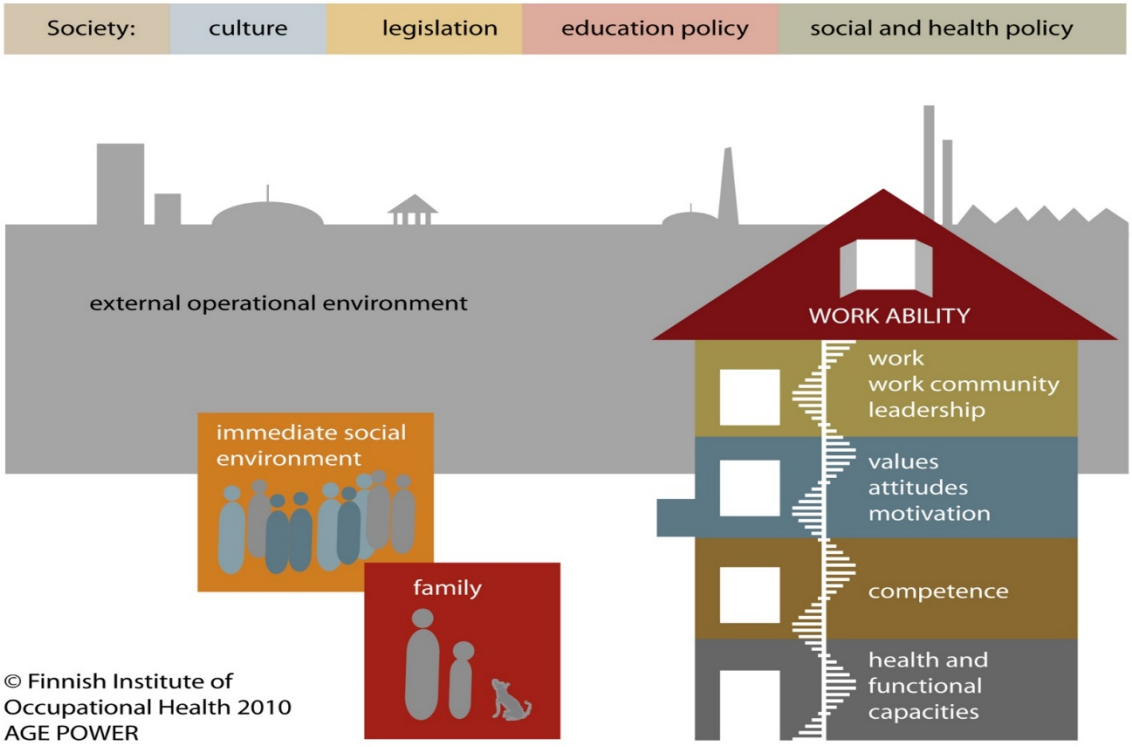
The review recognises that chronological age is not the most appropriate index of a person's abilities or needs and, instead, considers 'work ability', which looks at an individual's resources in relation to the demands of their work.

The review considers OSH factors that influence work ability and sustainable work within and outside the workplace. The report also considers measures to promote sustainable work across the life course. A 'life-course approach' to OSH focuses on improving prevention of risks for all workers, thereby reducing the damage to workers' health throughout life and limiting early exit from the workforce, improving the sustainability of work with high physical demands, and, in addition, making specific accommodations for individual workers if needed. This is key to promoting a longer working life and healthy retirement.

Therefore, when addressing these questions, the report also considers the implications of the cumulative exposure to hazards over the life course, the possible implications of increased cumulative exposure due to longer working lives, and OSH challenges with regard to sustainability over the life course.

There are many different determinants of health and work ability, which are influenced by a variety of interacting factors within and outside the workplace. For example, working conditions are influenced by the culture within a workplace, national OSH policy and services, national health policy and services, and the interaction between these factors. These interactions are represented by the Work Ability House (FIOH), shown below. This report also considers OSH, work ability and sustainable work in this broader context of influences

Figure 1: Model of work ability (FIOH)



- **Changes associated with ageing, the impact of work, and the implications for occupational safety and health and sustainable work**

A number of key findings were made in response to the question **'What changes occur in ageing individuals within the workforce, and what are the likely impacts of work along the life course on health and ability?'**:

- There are a number of *changes to physiological systems with age*, including reductions in aerobic power, muscle strength, stature, dexterity and mobility. The age at which these changes start to take place and the extent of such changes vary widely across individuals.
- *Older workers can often compensate for losses* to work-related functional capacity with strategies and skills gained through experience.
- *Physical strength and endurance is also very specific to individuals*, such that some older workers may be stronger than their younger colleagues.
- While *some cognitive abilities decline with age*, such as memory and reaction time, according to laboratory-based studies, there is evidence that work performance is unlikely to be affected, *as older individuals can generally compensate for any decline* with experience, better judgement and job-specific knowledge. *Strengthening of other mental characteristics*, such as ability to reason and motivation to learn, can also help older workers to compensate for any changes and maintain work performance.
- The *key elements of cognitive performance* important for workplace safety and health, such as intelligence, knowledge and use of language, *do not generally show any marked decrease until after the age of 70 years*.
- Statistical data show that *older workers are more likely than younger workers to suffer from chronic health problems*, such as cardiovascular disorders and musculoskeletal diseases. This does not necessarily affect their work performance and *many chronic diseases are controllable.*
- *Chronological age is not the most important determinant of health*, and ageing is not inevitably accompanied by illness and disease. Health is influenced by numerous other external factors, including lifestyle, exercise and nutrition.
- The *extent of exposure to hazards throughout the working life is one external factor that can influence the health of older workers*. For example, health can be affected by long-term exposure to chemical substances or physical work. There can be a long latency period before the effects of exposure are seen, as is the case with exposure to asbestos.
- *In contrast to some stereotypical views of the abilities of older workers, they are an asset to organisations*. Older workers are often more reliable than younger workers and often show a greater level of commitment. Furthermore, turnover and (short-term) absenteeism rates are often lower among older workers than younger workers, and they have a wider diversity of expertise, knowledge and skills.

The key findings that were made in relation to the question **'What are the implications of these changes and the impacts of work along the life course in relation to OSH and sustainable work?'** are summarised below:

- *Cumulative exposure over the course of working life* to a wide variety of physical and chemical agents has implications for occupational health and, therefore, the sustainability of work.
- *Physiological changes* can lead to the deterioration of physical capabilities. This does not necessarily affect work performance, but can result in a reduced tolerance of certain aspects of physical work. There is evidence that *long-term exposure to demanding work increases the impact of deterioration.*
- While most jobs do not require workers to work at full physical capacity, some older workers with physically demanding jobs may be working at (or close to) the limit of their capacity and may, therefore, be more at risk of musculoskeletal injuries or chronic fatigue than their younger counterparts. However, experience may protect against this to some extent. In other words, the

propensity for injury is related more to the difference between the demands of the work and the worker's ability to work than to age.

- In general, the *prevalence of musculoskeletal disorders (MSDs) increases with age*, probably as part of the normal ageing process; however, declining health does not necessarily mean a decline in job-related performance. *Other factors, such as work demands, may have a greater influence on the risk* of developing work-related ill health than age. The increased prevalence of MSDs with age is most pronounced in workers involved in physically demanding jobs, irrespective of age.
- *A worker's physical capacity or ability to work should be used to determine if they are capable of performing a specific job and the associated risk of MSDs, rather than their age.* Employers may need to provide additional support, including adjustments to the work.
- *Some age-related changes could result in increased risk under certain circumstances*, for example exposure to extreme temperatures or driving at night.
- *Rates of accidents* at work associated with more than three days of absence are lower among older workers than among younger workers. However, older workers are more at risk of a severe or fatal accident. Although less likely to have an accident, older workers take longer to recover from any injury sustained. *Occupation, not age, is the dominant factor that contributes to risk of injury*.
- Generally, the evidence suggests that *work-related stress*, anxiety and depression increase with age and then decrease after the age of 55 years. The causes of work-related stress in older workers are different from those in younger workers. For instance, older workers are more likely to experience stress because of the responsibility they have for other people's work and the workload, rather than the physical work environment.
- There is evidence that *continuing to work in good-quality working conditions is associated with better physical health and psychological well-being* than being out of work. Good social support at work can contribute to a reduced likelihood of early retirement — workers need to be managed in an age-appropriate manner.
- There is evidence that *some older workers, but not all, have difficulties with shift work* and may need additional support or the option of non-shift work. Age is associated with changes in sleep patterns and a reduced tolerance of routine changes such as those usually associated with shift work. There is some evidence for a link between prolonged exposure to night work and breast cancer.
- The *experience of older workers* may enable them to increase their efficiency in the workplace (by learning to adopt different ways of working).
- Many age-related changes, such as hearing or vision changes, that could affect safety at work can generally be *corrected with simple aids or work adjustments*. This also applies to circumstances in which chronic disease affects performance at work.
- *Measures that make work less demanding for older workers would often benefit all workers*. For example, measures to prevent the development of MSDs as a result of manual handling, repetitive work, and static and awkward postures would benefit workers of all ages.

Chronological age is not the most important determinant of health and performance

The determinants of health status and performance, and the age-relatedness of both, are complex. There are a number of changes that occur across the life course in relation to physiology, psychology and human processing. However, it is apparent that ageing is a very individual process. Chronological age is not the most important determinant of health, and ageing is not inevitably associated with illness and disease. Furthermore, age is not the best indicator of performance or ability. Older workers are vastly different from each other because of the interaction of both external and internal factors with the ageing process. Important external factors include lifestyle, exercise and nutrition. No stereotype of older workers is likely to be true for all, even for the majority of older workers, particularly the belief that chronological age is the most important determinant of health or that older workers take more time off work (Benjamin and Wilson, 2005).

Weyman *et al*. (2013) concluded that chronological age is unlikely to be the best predictor of work preferences or ability, and that focusing on older workers may lead to good practice relevant to employees of all ages being overlooked. These authors stated that older workers essentially exhibit the same set of vulnerabilities as workers of other ages, even if considered a relatively high-risk or vulnerable group.

As mentioned above, one external factor that can influence the health and physical capacity of older workers is the extent of exposure to hazards throughout their working life. For example, health can be affected by long-term exposure to chemical substances or physical work, and there can be a long latency period before the effects of such exposure are seen, for example in the case of exposure to asbestos. Dworschak *et al*. (2006, cited in Weyman *et al*., 2013) stated that 'If workers are required to perform work under adverse conditions on a permanent basis, they will almost inevitably encounter health and performance problems as they grow older.' Work should maintain physical and mental health, not contribute to its deterioration. However, according to the European Working Conditions Survey (EWCS), workers aged 35-44 and 45-55 years are more likely to report that their health is at risk from work than those aged over 55 years, which has implications for the future health of these workers. Those aged 55 years or over in craft and elementary occupations are more likely to report that they do not think that they will be able to work until they are 60 years old than those in managerial or professional jobs. Therefore, to ensure that work is sustainable, it is important that it helps to maintain physical and mental health and does not contribute to its deterioration (Eurofound, 2012b, 2015a).

Demands of work: work ability — an individual's resources in relation to work demands

As mentioned above, age-related changes happen to individuals at different ages and to differing degrees, and may also be compensated for at work, so may not affect work performance. It should also be recognised that age-related changes are not the only factors that affect the ability to work. Whether any such change affects work performance or not also depends on the nature of the work itself, or, in other words, the demands of the work. The concept of 'work ability' looks at an individual's resources in relation to the demands of a particular job.

It is difficult to predict the effects that age-related changes may have on the work ability of those aged over 65 years, who will now more often continue to work because of increases in official pension ages. The effects of continuing to work longer may be both positive, in terms of keeping people active, and negative, in terms of exposure to occupational hazards.

Health problems may not or need not necessarily affect work performance

An individual's health may change with age, but age is not necessarily the best determinant of health status. In addition, having an illness does not necessarily mean that an employee's work will be affected. In certain cases, adjustments to work can enable an employee with a health problem to continue working. Evidence also suggests that, in general, good work has a positive effect on both physical and mental health and well-being, while not working has been associated with poor physical and mental health. The biggest barrier to working with a health problem may be employers' attitudes, rather than the health condition itself.

Work should be made easier and healthier for all, with specific measures for individuals if needed

According to the concept of 'sustainable work', workplaces should promote the health of workers of all ages and support those who have health conditions. This suggests that the first priority should be to improve risk prevention measures and make work easier for the benefit of all workers across the work-life course, especially in the case of mentally or physical demanding work, but also with regard to work that is associated with the risk of developing MSDs, such as working in awkward postures. It would appear that the workers who are most likely to have problems later in life if their ability to work declines, because their work is particularly demanding, are also most likely to have their health compromised by their work.

Although physical capabilities may decline with age, this need not necessarily affect work performance. Many changes, such as age-related vision changes, can be corrected by either personal equipment or simple workplace adaptions. In many cases, adjustments can be made to specific tasks. However, if such adjustments are not possible, the transfer of workers to less demanding work should be considered in order to retain experienced workers. Evidence suggests that the consideration of work ability — an

individual's resources in relation to the demands of the work — is the most appropriate way of determining whether or not any changes in a worker's health or capabilities puts them at an increased risk from their work.

Older workers should be viewed as an asset

Finally, older workers have been identified as a valuable asset to organisations, because they are often more reliable than younger workers and often show a greater level of commitment. Furthermore, turnover and (short-term) absenteeism rates are often lower among older workers than younger workers, and they have a wider diversity of expertise, knowledge and skills (Harrison and Higgins, 2006; cited in Okunribido and Wynn, 2010). It is important to be objective about the performance of older workers and counteract the stereotypical views of the abilities and attitudes of older workers that some employers may have.

- **Occupational safety and health measures and systems that support sustainable work and mitigate any potentially adverse effects on safety and health**

The findings related to the question **'What OSH measures can be considered to mitigate any potentially adverse safety and health effects and to promote sustainable work along the life course?'** are discussed in the following sections.

Models of sustainable work

In terms of OSH, the concepts of 'sustainable work' and the 'life-course approach' can be used to inform an integrated approach to improving working conditions for all, along with considering the individual changes that can occur with ageing and the implications of these changes for workplace safety and health. Various models have been put forward to help us understand the multifaceted nature of sustainable work. These models reflect the various influences from both within and outside the workplace and, therefore, highlight the importance of an integrated policy approach that includes an OSH component.

The four models briefly summarised in the review were selected because of their relationship to OSH, but also because they differ in their perspectives on other factors. These models are:

- the work ability concept (FIOH, 2010);
- a model to monitor sustainable employability (TNO, 2012);
- the conceptual framework on age and employment (Hasselhorn *et al*., 2014);
- the schema for understanding the domains encompassed by sustainable work (Eurofound, 2015d)

These four models of sustainable work present the various complex and interacting elements that can influence the sustainability of work and the work ability of individuals, and therefore the continuation of or early exit from work of those individuals. By improving understanding in this way, these models can help to inform improvements in policy and interventions aimed at retaining older workers in the workforce. The work ability concept (FIOH, 2010) has already been described above.

Occupational safety and health measures and systems to support sustainable work

The models described above depict influencing factors from within and outside the workplace. The report examined two important influences: the safety and health of working conditions, and the OSH systems, legislation and policy needed to ensure that safe and healthy working conditions are maintained, including the interaction between OSH and other policy areas such as health, social policy, employment and education in the context of sustainable work.

There is evidence that OSH performance needs to improve if the EU is to prolong the working life of its workforce, especially in some demanding jobs. According to the European Working Conditions Survey, significant proportions of the workforce report exposure to challenging working conditions such as painful and tiring positions, working at high speed or adverse social behaviour (Eurofound, 2015a). Long-term exposure to such working conditions could lead to early exit from employment.

Improved risk prevention for all workers

Key finding: *In relation to OSH, sustainable work consists of two main elements, both of which are covered by the European legal framework on OSH*: (1) ensuring work does not damage physical or mental health across the life course, by controlling risks to all workers (generic measures); and (2) taking additional steps if and when necessary to protect any particularly vulnerable groups or individuals.

Therefore, the first OSH priority, in terms of sustainable work, is to ensure that working conditions do not affect workers' health or their work ability negatively, or, put another way, to ensure that work contributes positively to the maintenance of workers' physical and mental health across the work-life course. To achieve this, continued efforts are needed to improve risk prevention and make work easier and safer for the benefit of all workers. Various measures that would make work easier for all workers have been identified in this report.

Specific measures for older workers if and when necessary

In addition to good OSH management aimed at reducing risks to all workers, additional specific measures are also needed for older workers if and when necessary, depending on the type of work and the individual, so that their work can be organised in a way that allows them to continue to work in a safe and healthy manner. This needs to be done on an objective basis, in order to avoid discrimination and actions being based on stereotypes of older workers. This implies that a diversity-sensitive risk assessment approach is needed. It is proposed that the assessment of work ability of individual workers could also be used as part of an OSH management approach based on risk assessment. Work ability assessment may be especially applicable to demanding working conditions. The report has identified various, often simple, accommodations that can be made to allow those with changed abilities or health conditions to continue working.

Key finding: '*Work ability' refers to an individual's resources (for example, physical capacity, attitudes, experience) in relation to work demands (for example, work content, work environment, work culture)*. The work ability concept has been incorporated into a self-assessment tool, the Work Ability Index, which can assist with the early identification of risks to individual workers in order to counteract them.

Occupational safety and health risk prevention measures and workplace accommodations

Various measures have been identified in this report that would make work easier for all workers, including changing the way tasks are carried out to avoid or reduce physically demanding work, exposure to repetitive work or dangerous substances, etc.; using equipment to make work easier; and improving career progression to avoid prolonged exposure to risks (in relation to, for example, highly repetitive work, which is often carried out in some female-dominated types of work).

In particular, measures to prevent the development of MSDs, caused by manual handling, repetitive work, or static and awkward postures, would benefit all workers and contribute to the sustainability of work. Taking frequent breaks and the use of properly adjusted ergonomic workstations is suggested for computer-based work.

The report has also identified various, often simple, accommodations that can be made, including the use of personal devices or equipment, or changes to working hours, tasks or roles, to enable individuals with reduced work ability or changes in health to remain in work.

Key finding: *OSH measures to make work easier for all and workplace accommodations to allow workers with declines in health or performance to remain in work are often very simple.*

General mitigating measures

In summary, the report has identified the following ***key measures that can mitigate*** adverse effects on safety and health:

- *A comprehensive approach to age management in the workplace*, to promote sustainable work and counter the effects of ageing, that includes OSH, health promotion and human resources measures.

- *Risk assessment can support sustainable working* by being used to identify risk prevention measures to improve working conditions for the whole workforce or identify measures for specific groups or individuals. Work ability evaluation can be used as part of risk assessment. OSH aspects of age management can be accommodated within the normal workplace risk assessment and management process.
- *Health surveillance monitoring* over time and *access to occupational health services* are issues that need to be addressed, particularly for temporary workers and small businesses.
- *Ergonomics has an important role to play* in reducing the demands of work for all workers and making specific adjustments for groups of workers or individuals.
- *Workplace health promotion interventions should be age appropriate, gender appropriate and inclusive of all age groups*.
- *Older workers can often benefit from appropriate flexible working arrangements*, allowing them to accommodate other activities such as responsibilities as carers or to facilitate working with health problems. Social policy also influences whether or not workers can combine caring responsibilities and work.
- *Other measures* include maintaining up-to-date skills and knowledge, with training methods adapted to different age groups; and viewing older workers as an asset and developing their roles, for example through training and mentoring of younger, less experienced workers.
- The *prevention of injury and ill health in younger workers* is an essential part of a sustainable work approach. The promotion of 'healthy schools' and risk education in schools is also part of a lifelong approach.
- *Rehabilitation* should be focused on staying in work, and early interventions are crucial. Rehabilitation programmes should be interdisciplinary. Simple workplace accommodations can often allow workers with chronic diseases to remain in work. More needs to be done to support individuals living with chronic MSDs, who are either in work, or planning to return to work in future.
- *Specific gender-related issues*, in relation to sustainable work, need to be taken into account, as in any other OSH area. Such issues include reducing the high demands of certain jobs in which women predominate, for example health care and cleaning; workplace measures to support women going through the menopause; the double workload of family carers; and equal access to rehabilitation services.
- *A sector- or job-specific approach* allows interventions to address the specific work challenges identified and takes account of the specific context. Many of the measures identified to reduce workloads in specific sectors would benefit all workers in the sector.

The following figure was produced by the Federal Institute for Occupational Safety and Health (BAuA) in Germany to depict various measures in the workplace that contribute to work ability and sustainable work.

Figure 2: How to improve work ability and promote sustainable work in the workplace (Sedlatschek, INQA project, BAuA, undated)

Support of OSH systems to promote sustainable work

Key finding: As suggested by the models*, an effective OSH system is needed to support the approach to sustainable work* of combining improved protection for all workers with measures for individuals at greater risk as and when necessary.

Takala *et al*. (2009) defined elements of an effective OSH system and the tools it requires: legal measures; enforcement; services available to enterprises and organisations, such as occupational health services; incentives; awareness raising and campaigns; knowledge and solutions; networking for exchange of good practice; and cooperation between employers and workers, for example through tripartite advisory committees. All of these areas are relevant to achieving sustainable work.

As mentioned above, the European OSH legal framework is based on risk assessment and combines the collective measures of protecting all workers as the priority with work adapted to individual workers and measures to protect vulnerable groups. This framework is supportive of achieving sustainable work if effectively implemented. The promotion of well-being in addition to risk prevention requirements is likely to increase the impact of legislation with regard to supporting sustainable work. The modern labour inspectorate combines enforcement activities with the provision of support, advice and information to workplaces. To carry out these roles, a labour inspectorate needs to be equipped with the appropriate tools and expertise to apply its activities to a diverse workforce.

The importance of access to occupational health services, including health surveillance throughout the working life, has been highlighted as an issue in this report. This is a problem particularly for small businesses and temporary workers, such as construction workers or cleaners, many of whom may be migrants and perform the most demanding work. The provision of basic occupational health services linked to primary health care has been suggested as one way to greatly increase the coverage of small businesses and workers not covered by employers' occupational health systems or work insurance systems. Small businesses in particular need access to OSH support in general, for example for risk assessment, and especially with regard to assessments of individual workers and for determining risk prevention measures and suitable workplace adjustments for individuals. A sector-based approach may be most effective for small businesses and could be more easily targeted to their specific needs.

Work-focused rehabilitation services are also highlighted in this report as being of key importance for workers and also small businesses. This implies the need for an integrated approach between health and social policy and employment and OSH policy, as covered by the models.

Awareness raising campaigns should be implemented to disseminate the benefits of older workers to a workplace and raise awareness of those elements of the workplace that are not suited to their needs

(Okunribido and Wynn, 2010). However, this is likely to have a greater impact if combined with support and incentives for small and medium-sized enterprises (SMEs) to improve OSH, and to take measures to accommodate older workers or carry out workplace health promotion activities.

Continued research into OSH in general, and in relation to the ageing workforce in particular, is needed to improve knowledge and solutions. Existing OSH knowledge and best practice needs to be shared, including best practice on how to support small businesses in the context of an ageing workforce.

OSH authorities and organisations need to take a strategic approach to achieving sustainable work. The most effective way to do this is likely to be by incorporating or mainstreaming age and other areas of diversity throughout their strategy and practices. The diversity strategy of the Austrian Labour Inspectorate is a good example of how this can be done.

OSH systems can also promote a life-course approach that starts before working age, through cooperation with education policy, to embed risk education in school curriculums and promote health in schools, including through raising awareness of the ergonomics of furniture and other elements that could contribute to the development of MSDs.

Integrated policy approach

Key finding: As depicted in the conceptual models relating to sustainable work, *improving the retention of older workers is not just a function of maintaining their health and capacity and providing quality working conditions, but it is also essential to take other inter-related factors into account*, including motivation, learning opportunities and broader socio-political and institutional factors, such as income distribution, and pension and tax regimes.

There are many social and economic factors which interact to influence strongly health and wellbeing (Marmot, 2013) and also skills and motivation to work. As mentioned above with regard to rehabilitation, the models for sustainable work depict how various policy areas outside the workplace interact in the context of the sustainability of work, emphasising the importance of an integrated policy and services approach that includes OSH.

Given the evidence of persisting risks, especially in some sectors, considerable improvements to OSH are needed in many instances to prolong working lives. In cases in which work demands exceed an individual's work ability, because of the working conditions or declines in workers' health, even after accommodations have been made, there will need to be provisions for them to either change to another field of work entirely or exit from the workforce. Therefore, complementary policies and services are needed to support workers who, unavoidably, have to exit employment early. This, again, underlines the importance of an integrated policy approach.

- **Gaps in the knowledge**

Finally, the review identified a number of evidence gaps. An improved understanding is needed of how to make work sustainable for all ages and promote work ability and the needs of workers throughout the life course. More evidence is needed on the effectiveness of potential interventions on workers of any age. Furthermore, more knowledge is needed in relation to extending the working life beyond 65 years of age, for example in relation to work capacity and a potential increase in the length of exposure to work hazards.

- **Overall conclusions and possible policy implications**

Economic measures, such as increasing the official pension age, will be successful only if workers remain able to work and retain their physical and mental health into retirement. Work should allow the maintenance of physical and mental health, not contribute to its deterioration.

The overall aim of OSH in relation to sustainable work is to limit early exit from the workforce and ensure that working allows healthy workers to maintain their physical and mental health throughout their work-life course, and remain healthy into retirement.

While many changes in health and ability can be linked to age, ageing is not necessarily associated with ill health or declining performance. There is a huge variation in health and ability among workers of the same age. In addition, older workers can often compensate for losses to work-related functional capacity

with strategies and skills gained through experience. The focus of OSH in relation to age management should be on work ability in relation to work demands, not chronological age.

Cumulative exposure to demanding work across the work-life course can have a significant impact on health and functional ability, so is a particular concern with regard to sustainable work.

There is evidence that continuing to work under good-quality working conditions is associated with better physical health and psychological well-being than being out of work.

Improved OSH management to reduce risks and make work easier for all workers could have a significant impact on the sustainability of work. A life-cycle approach to OSH and sustainable work is needed for the health of workers to be maintained.

Specific measures for older workers should be taken if and when necessary — depending on the type of work and the individual — and should avoid discrimination and not be based on stereotypes of older workers.

Measures to make work less demanding would often benefit all workers, for example measures to prevent MSDs caused by manual handling, repetitive work, and static and awkward postures.

The tool of risk assessment can support sustainable working by identifying risk prevention measures to improve working conditions for the whole workforce or identifying measures for specific groups or individuals. OSH aspects of age management can be accommodated within the normal workplace risk assessment and management process. Individual work ability assessments can be used as part of risk assessment.

Often simple workplace accommodations can allow workers with health or performance declines to remain in work. In the workplace, human resources and OSH departments should cooperate on age management and related measures.

Older workers often benefit from flexible working arrangements, allowing them to accommodate other activities such as responsibilities as carers.

Effective, robust OSH systems are needed that are equipped to support SMEs and atypical workers and that have diversity issues mainstreamed into their strategy and actions. Access to basic occupational health services is an issue for small businesses, and health surveillance across the work-life course is needed for those workers not currently covered. OSH systems should promote well-being at work, as well as improved risk prevention measures, to achieve sustainable work.

If effectively implemented, the European OSH legal framework, based on risk assessment, combining collective measures to protect all workers as the priority with work adapted to the individual worker and measures to protect vulnerable groups, is supportive of achieving sustainable work.

A sector-based approach may be most effective for small businesses and can be more easily targeted to their specific needs.

Many factors influence the sustainability of work, from both within and outside the workplace. The integration of policies and services is needed, including between OSH, employment, education, and public health and social security, both to promote sustainable work, in order to minimise early exit from employment, and to make provisions for those who, unavoidably, need to change occupations or exit the labour market.

A comprehensive approach to age management would incorporate the fields of OSH, health promotion and human resources.

As with all areas of OSH policy, gender-related issues should be taken into account in relation to sustainable work.

Further research is needed, including in relation to demanding work and working sustainably after the age of 65 years. Sharing experiences of strategy development and the implementation of interventions should be promoted.

Older workers are valuable assets to organisations. Increased efforts are needed to counter stereotypical views and discrimination, and support organisations in prolonging the working lives of their employees.

1 Introduction

1.1 Health and safety of older workers at work

This review forms part of a series of activities that have been carried out as part of a larger project of the European Agency for Safety and Health at Work (EU-OSHA), initiated by the European Parliament. The project, 'Safer and Healthier Work at Any Age', aims to enhance the implementation of existing recommendations, facilitate the exchange of best practice and encourage further investigation of possible ways of improving occupational safety and health (OSH) to improve the sustainability of work throughout the life course, in the context of the ageing workforce.

The project supports the objectives of the European Union (EU) Strategic Framework on Health and Safety at Work 2014-2020 to address the ageing of the workforce, emerging new risks and the prevention of work-related and occupational diseases (EC, 2014). The Framework states that risks affecting particular age groups, disabled workers and women warrant particular attention and require targeted action. It also emphasises that OSH policy can contribute to promoting equal opportunities. It includes a specific action to promote the identification and exchange of good practice on ways to improve OSH conditions for specific categories of workers, e.g. older workers, inexperienced younger workers, workers with disabilities and women. It also includes an action to promote rehabilitation and reintegration measures, and it stresses the need to consider the gender dimension in relation to OSH and age.

Through the project 'Safer and Healthier Work at Any Age', the European Parliament seeks "to promote a European workforce with a balance of youth and maturity which is regarded as being best able to respond to the rapidly changing circumstances associated with globalisation and to encourage throughout the Union human resource management with an effective long-term strategy that permits appropriate adjustments in careers and training by focusing on developing skills and attenuating the process of decline' (Official Journal of the European Union, 2012). The present review contributes to raising the awareness and understanding of the issues associated with OSH and older workers and how to achieve sustainable work. It provides an overview of key issues, but is not a comprehensive review.

1.2 Ageing and work

Ageing is often considered from a number of different perspectives, including the following:

- Chronological ageing — this relates to calendar age and is often the method used to define different cohorts or descriptions of groups of workers, including older and younger workers.
- Biological ageing — this relates to measures of how organs or biological systems age over time, and includes measures such as maximal oxygen uptake or bone density. A number of such measures are correlated with chronological age, including lung function, grip strength and hearing ability. These have relevance in relation to physical capacity requirements in different occupational groups (Beers & Butler, 2012).
- Psychological (psychosocial) ageing — also referred to as subjective age; this relates to the age that people feel they are. It can also be seen in the context of the social perception of age, a perception that is influenced by age norms in society (Kooij *et al.*, 2008). Research has shown that subjective age can be a valid measure of the personal experience of ageing, and has been associated with health and well-being.
- Functional ageing — this is associated with workers' performance. The concept of functional ageing recognises that there is a wide diversity in individual differences in performance in relation to chronological ageing (Kooij *et al.*, 2008).
- Social ageing — this refers to the norms associated with the chronological age of people in a given population, and their perceived roles and value in society within that population. It is thus associated with issues such as age discrimination.
- Organisational age — Kooij *et al.* (2008) suggested the concept of organisational age as a way to reflect the ageing of individuals in jobs or organisations. Examples of this include seniority in

an organisation. It also relates to issues of career stage, ageing norms within an organisation and skill obsolescence (Kooij *et al.*, 2008).

Further concepts in relation to ageing include 'successful ageing', used most frequently in the USA, and 'active ageing', used most frequently in the EU (Foster & Walker, 2014).

'Successful ageing' was a term coined in the mid 1970's, when it was understood that ageing and illness are different processes and that ageing is not always associated with a loss of function or an increase in the likelihood of disability. The introduction of this term was associated with a change in the focus of research, from illness and age to staying healthy and doing well. However, the concept prioritises individual health and medical criteria, placing the wider social aspects of ageing lower down the hierarchy. There is also a concern that the concepts of success are associated with a pass or fail approach, with no allowance made for relative success (Foster & Walker, 2014).

The term 'active ageing' began being used in the 1990s and was closely linked to activity and health (Foster & Walker, 2014). The World Health Organization (WHO) defined it as 'the process of optimising opportunities for health, participation and security in order to enhance quality of life as people age' (WHO, 1994). The active component was further defined as 'continuing participation in social, economic, cultural, spiritual and civic affairs, not just the ability to be physically active or to participate in the labour force' (WHO, 2002). However, Foster & Walker (2014) noted that much of the focus of active ageing has been on extending working life. The authors recognised that this focus needs to be broadened, so that active ageing not only is about creating opportunities for extending working life, but also results in opportunities to contribute at the community level through volunteering or mentoring opportunities.

There are two concepts used in this report to consider ageing in relation to work and OSH:

- Work ability — this considers the resources of an individual in relation to the demands of the work. Work ability can be influenced by a number of factors, not only the functional ability of the individual, but also other attributes of the individual and factors in both the work and the wider social environments (e.g. Ilmarinen, 2001).
- Sustainable work — this concerns, among other factors, ensuring good-quality working conditions in general throughout working life, and also age-appropriate working conditions, in order to maintain health and well-being (e.g. Eurofound, 2012a).

1.3 Background: why be concerned about age?

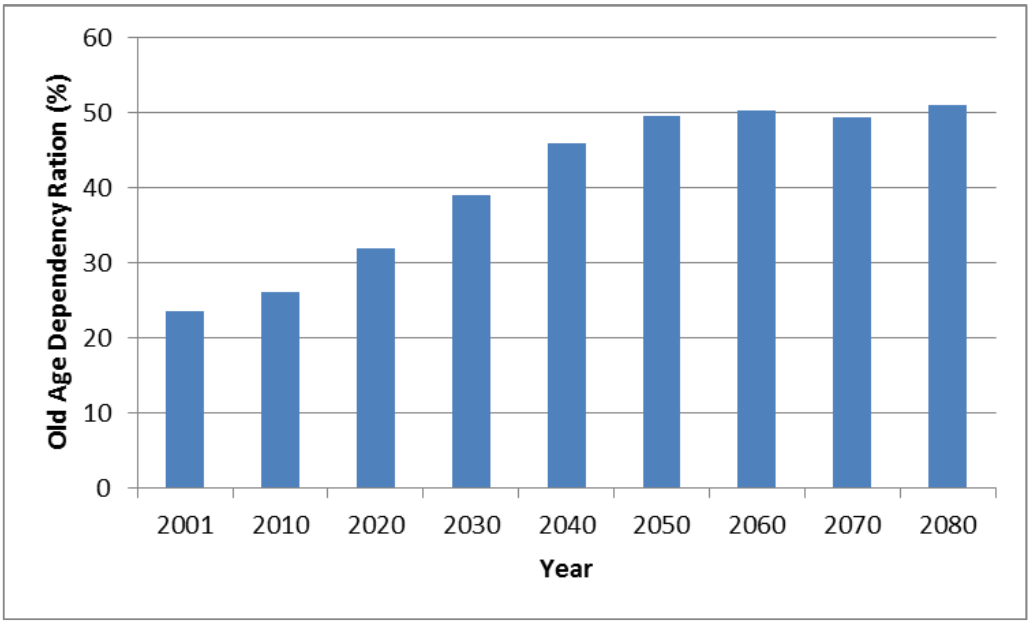
1.3.1 More older people

The proportion of older people in the general population is increasing across the EU. Data from Eurostat show that, in 2012, 17.9 % of the population were aged over 65 years, compared with 16.2 % in 2003. Provisional Eurostat data show a continued increase to 18.5 % in 2014 (at the time of writing, the Eurostat data for 2014 remained an estimate; Eurostat, 2015a).

The ratio of people aged 65 and over relative to those of working age (15-64 years), namely the old-age dependency ratio, is increasing in the EU. As can be seen in figure 3, it is projected to increase from 27.8 % to 50.1 % between 2013 and 2060. This implies that the EU would move from having four working-age people for every person aged over 65 years to about two working-age persons. This trend is putting significant pressure on public spending. It is estimated that, by 2060, age-related public expenditure in the EU will reach 12.9 % of gross domestic product (GDP) for pensions, 8.3 % of GDP for health care and up to 3.4 % of GDP for long-term care (EC, 2015; Eurostat, 2015b).

As well as an increased proportion of older people, such people are also expected to live longer. In the EU-28, male life expectancy at birth has increased from 74.5 years in 2002 to 77.4 years in 2012, and female life expectancy at birth has increased from 80.9 years in 2002 to 83.1 years in 2012 (Eurostat, 2015c). Equally importantly, life expectancy at the age of 65 has increased in males from 16.3 years in 2004 to 17.7 years in 2012, with an increase for females from 19.9 years in 2004 to 21.1 years in 2012 (Eurostat, 2015d).

Figure 3: Projected old-age dependency ratio (%) by year in the EU-28 (Eurostat, 2015b)



Note: This figure uses actual data for 2001 and 2010 and Eurostat projections for 2020 to 2080.

1.3.2 More older workers

The ageing of the general population in the EU is mirrored by the ageing of the working population. The European Commission notes that, 'Retaining ageing workers within an otherwise shrinking European labour force is essential for maintaining the capacity of the European economy to grow and hence to create new jobs' (EC, 2012a). This perhaps reflects the earlier agreement of the Stockholm European Council, which, in 2001, agreed a target employment rate of 50 % for those aged 55-64, to be attained by 2010.

Between 2000 and 2010, the percentage of those aged over 55 years in employment rose in 25 of the then 27 EU Member States, the exceptions being Portugal and Romania. Although the Stockholm target was reached by only 11 EU Member States, overall employment rates of over-55s increased on average to over 46 % (Eurofound, 2012a). This varies considerably between countries (e.g. from 36.3 % in Malta to 73.6 % in Sweden in 2013).

A gender difference is apparent in these figures, perhaps as a result of positive efforts to increase employment among women and also of the desire of some older women to return to some form of employment once their children are older. Between 2000 and 2010, the employment rate of older workers increased more rapidly in women (+11.4 percentage points) than in men (+7.7 percentage points), although the employment rate in older women in 2010 (38.8 %) remained lower than that for men (54.6 %).

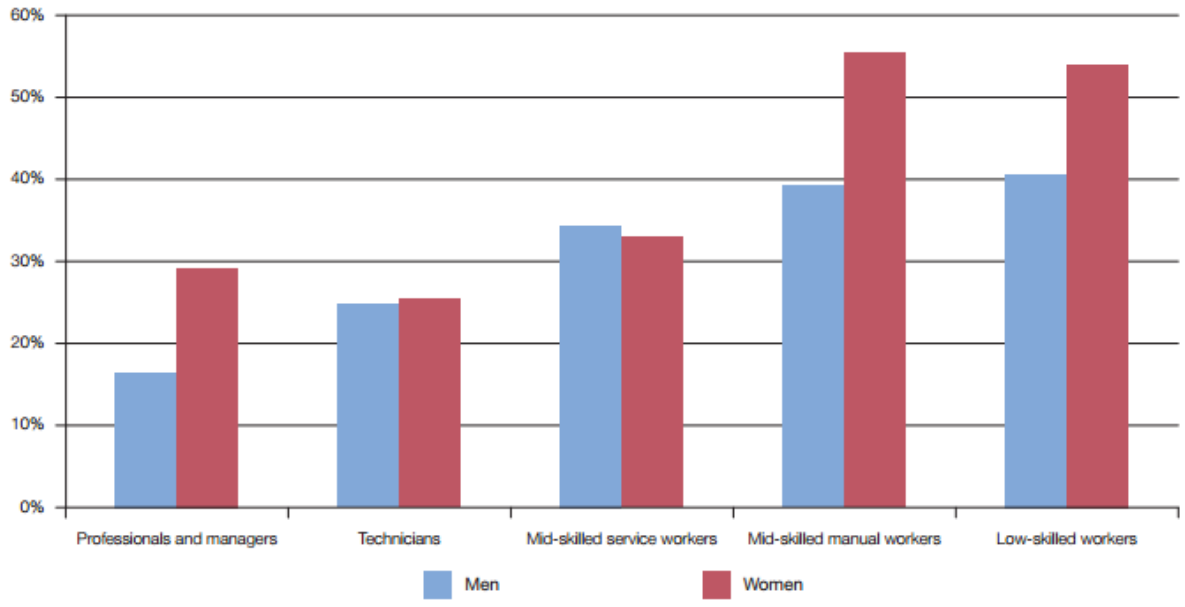
The European Foundation for the Improvement of Living and Working Conditions (Eurofound) reported that a variety of measures have already been implemented in some Member States to retain older workers in employment (Eurofound, 2012a). Such initiatives are wide ranging, including pension system reforms, raising the statutory pension age, reducing incentives for early retirement and providing incentives to promote lifelong learning and skills development in the workplace. Other, more targeted, policies include financial incentives for employers to retain older workers in and attract them into employment, financial incentives for employees to stay in employment for longer, gradual/phased retirement schemes and flexible working for older workers. Eurofound also reported that the average effective retirement age in the then EU-27 had increased from 61.5 years in 2000 to 62.3 years in 2010. The official retirement age in many Member States has now risen beyond 65 years of age for both men and women, with many Member States planning further increases, motivated by concerns of meeting state pensions.

1.3.3 Implications for occupational health and safety

Economic measures such as raising the official pension age will only be successful if workers remain able to work and retain their physical and mental health into retirement. This requires measures to improve occupational health, among other measures. In particular, raising the official pension age has implications for OSH. If the length of working life is increased, workers may be exposed to hazards for a longer period of time, which may have implications, particularly for any cumulative health effects of such exposures. Furthermore, there is the question of the capacity of workers to continue working as they have been, with official pension ages continuing to rise, especially in relation to physically or mentally arduous working conditions. According to the sixth European Working Conditions Survey (EWCS 2015), many blue-collar workers still report being exposed to high levels of work intensity, while also reporting low levels of job autonomy (Eurofound, 2015a).

Eurofound reported that, of those aged 50-54 years, 33.7 % did not think they would be able to do the same job at 60 years of age (Eurofound, 2012b). However, this overall average masks potentially important differences in sub-groups of the working population. As illustrated in Figure 4, further analyses found that 55.4 % of women and 39.4 % of men in the mid-skilled manual workers group, and 54.3 % of women and 40.7 % of men in the low-skilled workers group, reported that they did not think they would be able to do the same job at 60. These percentages are significantly lower for both sexes for professionals and managers, technicians or mid-skilled service workers. It is also important to note that older women in low-skilled work are more likely to report that they do not think they will be able to do the same job at age 60 than men in low-skilled work.

Figure 4: Percentage of workers aged 50-54 years who do not think they will still be able to do the same job at 60 years (Eurofound, 2012b)



Eurofound (2012b) found that 'poor self-perceived health' is a key predictor of the likelihood of older workers leaving paid work. This is important, given that the prevalence of chronic disease increases with age (with 42.5 % of those aged 55-64 years reporting a long-standing illness or health problem, compared with 28.9 % of those aged 45-54 years). Chronic diseases may or may not be caused (or made worse) by work. However, there is a concentration of people with work-limiting health-related conditions in lower level, manual and low-skilled occupations. Workers affected by chronic diseases also report facing higher exposure to risks and hazards at work than their 'healthy' counterparts and less opportunity to influence their workload or working time. Therefore, to promote longer working life, it is also essential to help those with chronic conditions, regardless of origin, to function actively in work and to tackle any work-related causes (Eurofound, 2014).

The implications for OSH are considered in this report in two different, but linked, ways: the work ability or work capacity of an individual in relation to work demands, and the sustainability of work throughout the life course. The concepts of work ability and sustainable work are referred to in section 1.2.

Regarding workers, it is their ability in relation to their particular work which is of interest, not their health or functional ability per se. 'Work ability' is a concept that relates a range of individual factors that make up an individual's resources to the demands of the particular work. As such, the concept can take account of the fact that while, for example, physical functional ability may decline with age, factors such as skills and experience can enhance ability and, therefore, may compensate for loss of functional capacity (Ilmarinen, 2001). The demands of work can also be modified by factors such as work management and, according to the most recent model, the wider social environment.

Eurofound (2012a) states that, for workers to stay in work as they age, attention must be paid to creating good-quality working conditions, with appropriate work–life balance, employment security and lifelong learning opportunities throughout working life. This is what is meant by 'sustainable work'. This will help to protect their physical and mental health and prevent forced job changes or older workers exiting the workforce. According to Eurofound, 'achieving work sustainability for workers means ensuring that older workers can continue to meet their job demands and that the way the work is organised allows them to work in a manner that is healthy, protects them from vulnerability, and makes the best use of their experience and knowledge. It also means that, across all ages, both working conditions and career paths help workers to retain their physical and mental health, motivation and productivity' (Eurofound, 2015a). In addition to working conditions and physical and psychological health, it covers the expressive dimension of work, work–life balance and socio-economic conditions (Eurofound, 2015b). Therefore, the term embraces workers of all ages, not just older workers, thereby taking a life-course approach, and it is not limited to OSH.

Creating high-quality working conditions requires a wider understanding and appreciation of the influence of any changes in work capabilities or susceptibilities with age. Working conditions are only one of many different determinants of health; others include educational level, socio-economic status, physical environment (including the working environment), lifestyle, nutritional status, physical activity, genetics, stress and access to health care. Morgan & Ziglio (2007) describe an assets-based approach, in which a health asset is seen as 'any factor or resource which enhances the ability of individuals, communities and populations to maintain and sustain health and wellbeing and to help to reduce health inequalities'. Within this context, prevention and risk management at the workplace, as well as workplace health promotion, can help to sustain the health and well-being of the ageing workforce.

1.4 Research questions to be addressed

To understand the influence of any changes in work capabilities or susceptibilities with age, this review examines three questions:

- 'What changes occur in ageing individuals within the workforce, and what are the likely impacts of work along the life course on health and ability?'
- 'What are the implications of these changes and the impacts of work along the life course in relation to OSH and sustainable work?'
- 'What OSH measures can be considered to mitigate any potentially adverse safety and health effects and to promote sustainable work along the life course?'

In addressing these questions, the review recognises that considering workers only in terms of their chronological age is overly simplistic, as there are significant differences between individuals in the rate and nature of the ageing process. As outlined in section 1.2, the concept of functional ageing recognises that there is a wide diversity in relation to the performance of individuals of a particular age, such that, for example, an older worker can be fitter and strong than a young worker, an issue not taken into account when considering only chronological age. More useful still in the context of sustainable work is the concept of work ability, looking at an individual's resources in relation to the demands of their work, and this concept is used in this report.

The review is interested in the implications for OSH for achieving sustainable work across working life. A 'life-course' approach to OSH examines OSH risks and controls across the entire workforce, whatever their age, thereby accommodating individual differences while ensuring an appropriate level of protection for all. Adopting a life-course approach improves prevention for all workers, and reduces the damage to workers' health while limiting early exit from work and improving the sustainability of work in jobs that have high physical demands. This is key to promoting a longer working life and healthy retirement.

Features of such an approach include:

- being aware that changes made to reduce risks for older workers (e.g. by excluding them from the more demanding aspects of jobs) might increase the risks for the other (younger) workers who have to take these tasks on instead;
- recognising that the cumulative nature of many injuries (e.g. some musculoskeletal disorders (MSDs)) means that reducing the incidence of these MSDs among older workers entails reducing exposures to MSD risk factors, such as excessively heavy manual work, for younger as well as older workers.

Therefore, when addressing these questions, this report also considers the implications of cumulative exposure to hazards over the life course, the possible implications of increased cumulative exposure owing to longer working lives and OSH challenges to sustainability over the life course.

While gender issues are referred to in the report, a separate review was carried out covering women, the ageing workforce and OSH (EU-OSHA, 2016a).

2 Methodology

A state-of-the-art review, rather than a systematic review, of the literature was conducted for this report. A search protocol was developed to address specific topic areas identified by EU-OSHA in the context of the three research questions stated above (see Appendix A).

A number of different approaches were taken to identify relevant research and resources for this review, in line with the search protocol. Firstly, an assessment of the academic literature was carried out. Secondly, searches were performed on relevant EU and research institutes' websites. Finally, a search identified other grey literature using Scirus and OpenGrey.

A particular focus was given to identifying systematic reviews, meta-analyses, literature reviews, guidance and grey literature.

An initial screening was carried out independently by two researchers. Full publications were obtained of the selected documents for those documents that were deemed to fit these inclusion and exclusion criteria. Two researchers independently analysed the full texts and a joint decision was made on those to include in the review.

Information from the literature search was supplemented with references to projects and recommendations arising from various non-governmental organisations and other organisations active in the field at both European and national levels, particularly with regard to possible strategies or measures to promote sustainable work.

- **Limitations of the research reviewed**

When evaluating research in the field of ageing, research study design is an important consideration, and there is little longitudinal research to draw upon, i.e. research where the same sample or group of people has been followed up over a period of time. Comparing this with cross-sectional research, where different groups of people are evaluated at one point in time, or even where repeated cross-sectional groups have been evaluated at different times, can cause bias in the results when identifying differences or similarities between groups. This is especially important when examining age-related change, as comparison groups may have important differences (e.g. fit individuals over the age of 60 versus unfit 30-year-olds).

Other types of research in this area have a number of additional inconsistencies. Different reporting and recording systems are used internationally, making the collation and comparison of data from different countries difficult. In addition, the categories used to break down age groups often differ between studies, which has an impact on accurate comparisons. Thus, the 'ageing worker' might be aged 55+ years or some other cut-off. Another challenge is that all workers within the 'ageing worker' group will be considered to have the same characteristics, whereas, as the evidence below illustrates, the diversity of such workers means they are far from homogeneous.

Finally, in many studies, the widespread previous assumption of retirement at a certain age (usually 65 years) results in a lack of data available on individuals over 65 years old. As a result, the evidence available for workers older than this is often very limited.

3 Ageing, work and occupational safety and health

3.1 What changes occur in ageing individuals within the workforce, and what are the likely impacts of work along the life course on health and ability?

Key findings

- There are a number of *changes to physiological systems with age*, including reductions in aerobic power, muscle strength, stature, dexterity and mobility. The age at which these changes start to take place and the extent of such changes vary widely across individuals.
- *Older workers can often compensate for losses* to work-related functional capacity with strategies and skills gained through experience.
- *Physical strength and endurance is also very specific to individuals*, such that some older workers may be stronger than their younger colleagues.
- While *some cognitive abilities decline with age*, such as memory and reaction time, according to laboratory-based studies, there is evidence that work performance is unlikely to be affected, as *older individuals can generally compensate for any decline* with experience, better judgement and job-specific knowledge. The *strengthening of other mental characteristics*, such as ability to reason and motivation to learn, can also help older workers to compensate for any changes and maintain their work performance.
- The *key elements of cognitive performance* important for workplace safety and health, such as intelligence, knowledge and use of language, *do not generally show any marked decrease until after the age of 70 years*.
- Statistical data show that *older workers are more likely than younger workers to suffer from chronic health problems*, such as cardiovascular disorders and MSDs. This does not necessarily affect their work performance and *many chronic diseases are controllable.*
- *Chronological age is not the most important determinant of health*, and ageing is not inevitably accompanied by illness and disease. Health is influenced by numerous other external factors, including lifestyle, exercise and nutrition.
- The *extent of exposure to hazards throughout the working life is one external factor that can influence the health of older workers*. For example, health can be affected by long-term exposure to chemical substances or physical work. There can be a long latency period before the effects of exposure are seen, as is the case with exposure to asbestos.
- *In contrast to some stereotypical views of the abilities of older workers, they are an asset to organisations*. Older workers are often more reliable than younger workers and often show a greater level of commitment. Furthermore, turnover and (short-term) absenteeism rates are often lower among older workers than younger workers, and they have a wider diversity of expertise, knowledge and skills.

3.1.1 Introduction: the underlying science of change

The purpose of this section is to examine the physical and psychological factors that change with age and that may have an impact on an individual's ability to work, and the impacts that work itself may have on health and ability over the life course. The changes that take place can be categorised under three subsidiary questions:

- What age-related physiological changes take place in the human body, within the working population?
- What age-related cognitive or psychological changes take place in the human body, within the working population?
- What age-related changes in general health take place (e.g. degenerative MSDs, cardiovascular problems, etc.), within the working population?

The following sections aim to summarise the different changes associated with ageing. The impact of these changes on work and capacity depends greatly on each individual, and assumptions based on chronological ageing with regard to capacity may often be misleading. Ageing is a very individual process, and the differences between people of the same age, at any age, are often greater than those between different age groups. In addition, external factors, including exposure to hazards in the work environment, interact with the ageing process, and this is considered in this review.

3.1.2 Physiological changes with age

In relation to physiological change with age, a number of different physiological systems, and their interactions, need to be considered. It is important to understand that age-related change is part of the normal ageing process; it happens to individuals at different ages and to differing degrees. It should also be recognised that it is not the only factor that affects an individual's ability to work.

Drawing on a number of key review sources (Crawford *et al*., 2009, 2010; Harper & Marcus, 2006; Kenny *et al*., 2008; Martin *et al*., 2015; Yeomans, 2011), the following age-related physiological changes can be identified:

- Starting from the late teens/early twenties, a reduction in average aerobic power occurs of approximately 10 % per decade; there is accelerated decline after the age of 70.
- Starting from a similar point in time, average muscle strength and endurance decline over time. The losses are initially slow, but the rate of decline increases with age, becoming more apparent after the age of 65.
- Stature reduces and weight tends to increase with age. The former is often associated with degenerative spinal changes and can be indicative of diseases such as osteoporosis.
- Both postural balance and functional balance reduce with age.
- Joint mobility reduces with age.
- A relationship between increasing age and reducing hand dexterity has been widely reported in both the clinical and the scientific literature.
- Cardiovascular changes lead to a reduced response to extreme temperatures.
- The skin thins with age.
- Hearing deteriorates with age. As with many of the effects listed above, inter-individual variability means that this may not occur in many individuals during working life. A further factor here is that any age-related change may be accentuated by noise-induced hearing loss.
- Age-related visual changes occur from the mid-forties onwards. These include a decreased ability to see objects clearly, impaired visual performance in low levels of lighting, difficulties in correctly judging distances and the speed of moving objects, and problems in distinguishing between certain colour intensities.

As stated, the age at which these changes start taking place and the extent of such changes vary widely across individuals. Physical strength and endurance are very specific to individuals, such that some older workers will be stronger than their younger colleagues (Benjamin & Wilson, 2005). In addition, loss of physiological or functional capacity does not necessarily mean a loss of work capacity. Older workers can often compensate for losses in work-related functional capacity with strategies and skills gained through experience (Harrison & Higgins, 2006, cited by Okunribido & Wynn, 2010). Some impairments, such as changes to vision or hearing, can often be easily adjusted for with corrective aids (Yeomans, 2011).

It is widely recognised that many of these changes do not become apparent or have any meaningful impact under the age of 65 years. While this has meant that the implications of these changes for work have previously been limited, extending the working age beyond 65 years may increase the proportion of people in the workforce experiencing significant changes in physiological characteristics.

However, an alternative hypothesis is that some of these changes (e.g. the decline in muscle strength, increase in weight) may be artefacts generated by reductions in activity levels following retirement (at

65 years old). It can therefore be suggested that delaying the age of retirement, and therefore prolonging work-related physical activity beyond 65, might reduce the extent of such changes. In an added complication, where such changes are, at least in part, work related (e.g. the contribution of physical workload to degenerative musculoskeletal change), continuing to work may have a harmful effect. Studies reviewed by Yeomans (2011) suggest that regular exercise can delay and minimise declining physical capacity.

3.1.3 Changes in cognitive function with age

Some specific cognitive abilities do show a decline with age, such as memory, information processing speed, attention and reaction times. Some of these changes can be observed from as early as 45 years old (Bugajska *et al.*, 2006), although they can occur much earlier or much later. As with physiological changes, inter-individual differences can be considerable and dealing with 'average' or 'typical' response patterns can be misleading.

Ilmarinen (2001) suggested that the psychological changes that take place as an individual gets older and that have the most impact on working life are those related to the processing of information. In particular, weakened precision and a slower speed of perception have the most impact. Three systems are involved in this processing of information, including the sensory-perceptive system (taking in information), the cognitive system (processing information and determining its significance) and the motor system (acting on the information), all of which slow with age (Ilmarinen, 2001). In a review of the psychological aspects of ageing, Morgan (2004, cited by Crawford *et al.*, 2009) highlighted that there is a trade-off in older workers between the speed and the accuracy of task performance, as older workers are more likely to slow their work rate for increased accuracy. The author suggests that this is a deliberate action owing to an increase in their degree of caution, rather than an innate slowing. The consequence of this increase in the level of caution of older workers is a reduction in the number of errors they make.

Cattell (1971, cited by Crawford *et al.*, 2009) reported that there are two forms of intelligence — fluid and crystallised — which combine to form general intelligence. Fluid intelligence encapsulates tasks at the time of performance, such as problem solving, whereas crystallised intelligence is the result of earlier processing, such as verbal ability and sequential reasoning. It has been found that crystallised intelligence is better maintained and improved than fluid intelligence during the process of ageing. Thus, routine or procedural skills that have been learned earlier in life are maintained (National Research Council, 2004, cited by Silverstein, 2008), while those relying on fluid intelligence are more likely to deteriorate.

Morgan (2004, cited by Crawford *et al.*, 2009) referred to the 'use it or lose it' hypothesis in respect of improving (or at least maintaining) intellectual functioning. In practice, this proposes a relationship between the maintenance of intellectual activities and higher levels of educational attainment, together with an appropriate mental workload to maintain function and linguistic skills.

One the other hand, mental characteristics, such as wisdom, control of the use of language, the ability to reason and carry out complex processing, and motivation to learn can strengthen with age (Balters and Smith, 1990; Schaie, 1994; both cited by Ilmarinen, 2001). Yeomans (2011) concluded from a review of the literature that there is evidence that key elements of cognitive performance important for workplace safety and health, such as intelligence, knowledge and the use of language, do not generally show any marked decrease until after the age of 70.

While there is evidence that some specific cognitive abilities decline with age, much of it comes from laboratory-based studies, and there is little evidence to suggest that work performance declines with age (Griffiths, 2000; Yeomans, 2011). It appears that, where declines in cognitive abilities, such as memory or reaction time, do occur, this is unlikely to affect work performance because of older workers' ability to compensate for the decline with an increase in knowledge, experience and judgement. Research has suggested that the compensation strategies and skills of older workers benefit from recent training. This is particularly visible in jobs that are cognitively demanding (Hively, 2005, cited by Bugajska *et al.*, 2006), although experience has shown that similar outcomes can occur in physical jobs, with skilled workers learning or developing easier ways of working. Therefore, even though the speed

and precision of information processing may decrease as workers age, the increased experience they have gained during their working life may compensate for this, so that no overall deterioration of performance occurs as a result (Crawford *et al.*, 2009; Ilmarinen, 2001).

3.1.4 Age-related changes in general health

As well as changes in physiological and cognitive functioning, changes in general health also occur with age. Chronic diseases are diseases of a long duration and generally of slow progression. They include diabetes, cardiovascular diseases, MSDs and arthritis, asthma or chronic obstructive pulmonary disease, cancer, epilepsy, multiple sclerosis, hepatitis, human immunodeficiency virus (HIV) and mental disorders. The most common are MSDs, mental disorders and cardiovascular diseases. Some chronic disease may be work related. The Community Statistics on Income and Living Conditions (EU-SILC, 2008, cited by Heigl, 2013) reported that about 24 % of the working-age population (of the EU-27) suffer from at least one chronic health restriction. Once (current) pension age is reached, two out of three people suffer from at least two chronic diseases. As the workforce ages, there will be a higher prevalence of workers with chronic diseases (Eurofound, 2014). Regarding sustainable work, what is of interest is whether having a health condition affects an employee's work (Ilmarinen, 2005). This is what is meant by functional health.

As some health changes in older workers will be work related, the incidence of work-related ill-health and the extent to which it affects work ability is also of particular relevance to the sustainability of work. Regarding adverse working conditions that contribute to the development of health problems, the length of exposure to the adverse conditions is also relevant. Health effects can be the result of cumulative exposure or there may be a long latency period before health effects manifest themselves, as in the case of some diseases related to exposure to asbestos. Table 1 presents EU-27 data from the Labour Force Survey on the proportion of people reporting more than one work-related health problem in the preceding 12 months for different age groups. One limitation of the dataset is that it extends only to those of what would be regarded as 'normal' working age, and does not therefore include those aged 65 or over.

The proportion is the same in both the 45-54 and 55-64 age groups. This result is a little misleading, as it masks small differences, in opposite directions, for men and women when considered separately (i.e. an increase for men and a decrease for women in the older age group). In addition, noticeable differences between age groups and between genders become apparent when data for individual diseases are considered.

- For both men and women, the proportion reporting cardiovascular disease increases with age, while the proportion reporting 'stress, depression and anxiety' and 'headaches and eyestrain' decreases.
- For men, the proportion reporting hearing disorders and pulmonary disorders as their most serious work-related problems is higher among the 55-64 age group than in the 45-54 group.
- For women, the proportion reporting MSDs as their most serious work-related problem is higher among those in the 55-64 age group than in the 45-54 group.

A serious limitation of this data is that, when an individual is experiencing more than one health problem, the data only reports that which is regarded (by the respondent) as the most serious. Thus, the apparent increase in MSDs in older women might indicate that they now find them more of a handicap than previously, rather than women of this age developing MSDs for the first time. Care should therefore be taken in interpreting the data, and they can only be regarded as providing an indication of the minimum incidence of these conditions.

Table 1: Work-related health problems in the EU-27 in 2007 (Labour Force Survey)

	Males			Females			All		
Age group	**All**	**45-54 years**	**55-64 years**	**All**	**45-54 years**	**55-64 years**	**All**	**45-54 years**	**55-64 years**
Percentage reporting more than one work-related health problem in the past 12 months	12.8	15.8	16.5	12.7	15.8	15.0	12.8	15.8	15.8
Most serious work-related problem in the last 12 months (as the percentage of the total)									
Cardiovascular disorders	5.8	6.7	11.5	4.8	4.3	8.3	5.3	5.5	10.0
Hearing disorders	3.3	3.3	6.1	0.9	1.1	1.4	2.1	2.2	3.9
Pulmonary disorders	4.2	3.9	5.8	3.1	3.0	3.5	3.6	3.5	4.7
Musculoskeletal disorders	54.8	55.6	55.6	53.9	57.6	62.3	54.3	56.6	58.7
Infectious diseases	1.7	1.2	1.1	2.0	1.5	1.1	1.8	1.4	1.1
Stress, depression, anxiety	18.3	17.8	10.7	21.4	19.9	13.2	19.8	18.8	11.9
Skin problems	2.0	1.2	1.1	1.7	1.3	1.0	1.8	1.2	1.0
Headache, eyestrain	4.8	4.6	2.4	7.1	6.2	3.7	5.9	5.4	3.0
Other	5.4	5.7	5.8	5.2	5.1	5.5	5.3	5.4	5.7

Further analysis of some of the reported work-related health problems, in particular back pain and sleeping difficulties, shows an increase in the extent of such problems in the two decades before the age of 60, after which they decrease. It is suggested that this decrease is due to people in poorer health leaving the labour market, rather than any improvement in symptoms (healthy worker effect). Sleep difficulties are reported more frequently by older women, while men report a higher prevalence of back pain. The most common 'most serious' self-reported work-related health problems were MSDs and stress, anxiety or depression.

When examining health problems in older workers in general, Vendramin & Valenduc (2012), using data from the fifth EWCS, showed that workers aged 55-59 years are more likely to report having health problems than workers aged 50-54 years ([1]). While indicators of health problems, such as backache or sleeping difficulties, increased in the two decades between the ages of 40 and 60, they decreased for those still at work after the age of 60. The authors suggested that this was probably because those in poor health had left the labour market. In the United Kingdom, Crawford *et al*. (2009, 2010) identified, using the Labour Force Survey data, that the highest prevalence rates of ill-health in men were in the 55-64 age group, compared with a peak in the 45-54 age group for women. The data differentiates between those who had an ongoing health problem and those for whom the problem was new. These data show that incidence rates of 'new' illnesses decreased for men and women when over the age of 55 years. Yeomans (2011) suggested that such data also show that older workers continue in employment, despite having a health problem.

Data from the fifth EWCS show that poorer self-evaluated health is also strongly linked to occupational category, with manual workers or low-skilled workers being more likely to report poor health in the older age group than those in less manual/more skilled occupations. This might be the result of health problems being more likely to have an impact on work ability in such occupations, or it could be because these occupations are more likely to affect workers' health. The authors identified associations between lower self-evaluated health and painful working positions, lack of career prospects, tight deadlines, low levels of social support and inadequate working hours. Particularly for men, an association was also found between job insecurity and lower levels of self-reported health. Painful positions, shift or night

([1]) Note the different age bands used here, providing an example of one of the challenges faced in identifying patterns between studies.

work, and poor work–life balance are the main factors explaining why workers aged 50-59 feel that work puts their health at risk and negatively affects health (Vendramin & Valenduc, 2012).

The Wisconsin Longitudinal Study in the USA found that physical working conditions were a strong determinant of general health, which deteriorated significantly among those employed in physically demanding work, with the number of health complaints increasing significantly, demonstrating the long-term adverse effect of such work (Hoonakker *et al*., 2006, cited by Yeomans, 2011). Yeomans (2011) concluded that age itself does not increase the probability of developing a work-related health problem and that work demands and psychosocial factors may have a greater influence.

These findings illustrate the inequalities faced by different socio-economic groups, including in the older age groups, when it comes to work-related health and well-being. Social determinants of health should be considered in this context, where factors such as occupation, social position and education are important determinants of both general health and occupational exposure to hazards and risk at the workplace. In the context of extending working life, it is increasingly important to think not only about increasing average life expectancy, but also about increasing average 'healthy life years' expectancy. Generally speaking, we are living longer, but we are often living longer with chronic health conditions and disabilities. In addition, to fight health inequalities, a focus is needed on the growing gap in healthy life years between EU Member States and different socio-economic groups.

Crawford *et al.* (2009) cited estimates that suggest that, because of current lifestyles, there is likely to be an increase in mental illness; stroke; MSDs; breast, prostate and bowel cancers; diabetes; and coronary heart disease up to 2030 among the working-age population. However, it is not clear whether, in this context, 'working age' accommodates anticipated increases in employment among older people or whether this relates to the conventional view of 'working age' as being up to 65 years. Some of these conditions may have implications for physical and psychological work abilities that need to be accommodated in order to enable such workers to remain in the workforce. Yeomans (2011), on the other hand, cited evidence that general health and disability-free life expectancy are improving, for reasons such as a reduction in smoking.

Evidence shows that the prevalence of common health problems does increase with age; however, the issue is whether or not having a health problem affects workers' ability to perform at work. Evidence points to health problems and decreased general health as being one of the main determinants of exit from work (e.g. van den Berg *et al*., 2010; van Rijn *et al*., 2013). While health is an important determinant of work ability (de Wind *et al*., 2015), the majority of chronic health problems can potentially be controlled and are not associated with impairment or long-term incapacity (Waddell and Burton, 2006, cited by Yeomans, 2011). In addition, among others, work factors could play an important role in buffering the detrimental effects of poor health/health problems (Leijten *et al*., 2013, 2015). Therefore, having a health problem is not a valid reason to exclude an individual from the workforce (Crawford *et al*., 2009). In a major review of the health of the United Kingdom working population, Black (2008) stated that it is a fallacy that illness is incompatible with being at work and that individuals should only be at work if they are 100 % fit. The review suggested that employers should provide healthy workplaces and jobs that protect and promote the health and well-being of employees of all ages, while also providing support for people who have, or are at risk of developing, health conditions. This support may include adjusting or adapting work practices, patterns or job roles (Black, 2008). Yeomans' review (2011) also supported these conclusions. If health changes or age-related changes affect functional ability, then an individual's capabilities or resources can be assessed against the demands of their work (Ilmarinen, 2001). Workplace measures will be discussed further in in sections 3.2 and 4.

3.2 What are the implications of these changes and the impacts of work along the life course in relation to occupational safety and health and sustainable work?

Key findings

- *Cumulative exposure over the course of working life* to a wide variety of physical and chemical agents has implications for occupational health and, therefore, the sustainability of work.
- *Physiological changes* can lead to the deterioration of physical capabilities. This does not necessarily affect work performance, but can result in a reduced tolerance to certain aspects of physical work. There is evidence that *long-term exposure to demanding work increases the impact of deterioration.*
- While most jobs do not require workers to work at full physical capacity, some older workers with physically demanding jobs may be working at (or close to) the limit of their capacity and may, therefore, be more at risk of musculoskeletal injuries or chronic fatigue than their younger counterparts. However, experience may protect against this to some extent. In other words, the *propensity for injury is related more to the difference between the demands of the work and the worker's ability to work than to age.*
- In general, the *prevalence of MSDs increases with age*, probably as part of the normal ageing process; however, declining health does not necessarily mean a decline in job-related performance. *Other factors, such as work demands, may have a greater influence on the risk* of developing work-related ill-health than age. The increased prevalence of MSDs with age is most pronounced in workers involved in physically demanding jobs, irrespective of age.
- *A worker's physical capacity or ability to work should be used to determine if they are capable of performing a specific job and the associated risk of MSDs, rather than their age.* Employers may need to provide additional support, including adjustments to the work.
- *Some age-related changes could result in increased risk under certain circumstances*, for example exposure to extreme temperatures or driving at night.
- *Rates of accidents* at work associated with more than three days of absence are lower among older workers than among younger workers. However, older workers are more at risk of a severe or fatal accident. Although less likely to have an accident, older workers take longer to recover from any injury sustained. *Occupation, not age, is the dominant factor that contributes to risk of injury*.
- Generally, the evidence suggests that *work-related stress*, anxiety and depression increase with age and then decrease after the age of 55 years. The causes of work-related stress in older workers are different from those in younger workers. For instance, older workers are more likely to experience stress because of the responsibility they have for other people's work and the workload, rather than the physical work environment.
- There is evidence that *continuing to work in good-quality working conditions is associated with better physical health and psychological well-being* than being out of work. Good social support at work can contribute to a reduced likelihood of early retirement — workers need to be managed in an age-appropriate manner.
- There is evidence that *some older workers, but not all, have difficulties with shift work* and may need additional support or the option of non-shift work. Age is associated with changes in sleep patterns and a reduced tolerance of routine changes, such as those usually associated with shift work. There is some evidence for a link between prolonged exposure to night work and breast cancer.
- The *experience of older workers* may enable them to increase their efficiency in the workplace (by learning to adopt different ways of working).

- Many age-related changes, such as hearing or vision changes, that could affect safety at work can generally be *corrected with simple aids or work adjustments*. This also applies to circumstances in which chronic disease affects performance at work.
- *Measures that make work less demanding for older workers would often benefit all workers*. For example, measures to prevent the development of MSDs as a result of manual handling, repetitive work, and static and awkward postures would benefit workers of all ages.

3.2.1 Introduction

This section explores both the specific implications of the changes that occur with age (e.g. what are the implications of a reduction in aerobic power for work ability?) and the implications of using a risk-based approach. This latter view examines the relationships between certain OSH hazards and the consequent risks to the safety and health of older workers. It also considers the impact of cumulative exposures to hazards along the life course. Changes in a worker's susceptibility to hazards can be mediated via a number of pathways (for example, the risk of accident might be a function of both physiological and cognitive changes) and so this latter approach effectively integrates all changes related to age.

In many instances, statistics suggest a lower apparent impact of age-related change on those in work than might be expected. This encompasses a wide variety of work and risks, including those taking early retirement from the emergency services, those in heavy manual jobs and those engaged in shift work. It appears to be widely accepted, at least in part, that this is illustrative of a 'healthy worker effect', where those least able to tolerate a set of working conditions leave employment. Although superficially reducing incidence rates of problems, this is clearly counteractive to the need to retain workers in employment. On the other hand, as mentioned in the previous section, neither changes in age-related capacity nor changes in health necessarily have an impact on workers' ability to continue working. Firstly, they may not hinder performance to any great extent; secondly, any change in performance is relevant only in relation to the demands of the specific work; and, thirdly, it may be possible to make adaptions at the workplace to overcome or reduce any changes in work ability.

The following sections examine:

- the impacts of certain physiological changes on work capacity;
- the relationship between age and the risk of workplace accidents;
- the relationship between age and risks associated with physical, biological and chemical hazards;
- the relationship between age and risks of work-related MSDs;
- the relationship between age and risks leading to physical and/or mental fatigue
- the relationship between age and risks arising from psychosocial hazards;
- the relationship between age and risks arising from night work and shift work; and
- the implications for OSH and sustainable work of all of the above.

3.2.2 Impacts of changes in physical capabilities on work capacity

Various physiological changes can lead to a deterioration in physical capabilities. In physically demanding jobs, a decline in work capacity can mean that individuals are unable to meet their job requirements later in working life, although most jobs do not require workers to work at full physical capacity and it is unlikely to be an issue for older workers in sedentary or less physically demanding work. The following lists looks at whether physiological changes can have an impact on work capacity:

- The deterioration of balance and mobility with age can present challenges for older workers in jobs where good balance is required (e.g. in some construction jobs). Normal changes in mobility are unlikely to have any meaningful impact. Where such losses are accelerated (e.g. through early onset of joint diseases such as osteoarthritis), it could be of significance but, as this is not the typical decline, it may be more appropriately considered as a disability issue.

- There has been relatively little research into the impact of age-related deterioration in dexterity in the workplace. Dexterity is to some extent a specialised aspect of (joint) mobility, although it also relates to other issues such as muscle strength, control and coordination (Martin *et al*., 2015). As with mobility, it appears to not be a particular issue with normal rates of decline in capability, but might be a problem in individual cases of disease-related acceleration.
- Changes in stature or weight with age are unlikely to have an impact on work capacity directly, but may do so indirectly through having an adverse impact on physical fitness. Concerns have been expressed that the increasingly sedentary nature of modern lifestyles is associated with deleterious health outcomes, which will have significant implications for older workers in the future (Tremblay *et al.*, 2010). Although increases in levels of obesity are visible within the European population, there is now concern that other health impacts may be occurring as a result of a lack of physical activity. These include associations identified between colorectal, endometrial, ovarian and prostate cancer and sedentary behaviour (Lynch, 2010).
- Finally, a reduction in aerobic power can be a problem for workers in physically demanding jobs with high fitness and capacity requirements. Shephard (1999, cited by Crawford *et al*., 2009) identified that machine-paced tasks set at 32 % of the average maximal aerobic power for a 40-year-old result in an average 65-year-old man working at 105 % of maximal power, and an average 65-year-old woman working at 140 %. Sluiter & Frings-Dresen (2007) reviewed evidence on the work ability of firefighters. Physiological data showed that the aerobic capacity of firefighters decreased with age, but also that there were significant inter-individual differences within the different age groups. Yeomans (2011) found considerable agreement in the literature that age-related declines in physical capacity do not normally adversely affect job performance, suggesting that this may be because very few jobs require high aerobic capacity and muscular strength to be maintained over a long period of time, or because older workers adapt their ways of working to compensate for any physical declines.

In relation to general physical deterioration with age and demanding work, Kenny *et al*. (2008) highlighted the importance of understanding that older workers may be working at the limit of their capacities and may be more at risk of musculoskeletal injuries or chronic fatigue. However, Shephard (1999, cited by Crawford *et al*., 2009) identified that older workers do not complain of fatigue very often and, like Yeomans (2011), suggested that experience may increase efficiency in the workplace (through the learning of different ways of working). Alternatively, because age is often linked to seniority in a company, access to less physically demanding jobs may be an option for older workers.

Yeomans (2011) described a number of measures that could be taken in relation to physically demanding work, including assessing work ability on an individual basis in relation to work demands; moving workers who are experiencing difficulties to tasks requiring less heavy physical work; reducing heavy lifting and carrying tasks; allowing workers to use their skills and experience to train and supervise others; providing equipment such as power tools and handling equipment; improving lighting conditions; and specific job accommodations after injury.

From a life course perspective, understanding the physical capacity of all age groups within the workforce is important, as younger workers may not be work-hardened compared with experienced older workers who have learned how to pace themselves. In addition, many measures that could reduce the work demands on older workers, such as handling equipment or improved lighting, would be likely to benefit workers of all ages (Yeomans, 2011).

3.2.3 Risk of workplace accidents

- **Accidents and injuries**

Data on standardised incidence rates for accidents at work resulting in over three days' absence are presented in Table 2. Rates are higher for men than women in both age groups and overall. For men of both age groups (55-64 and 65+), rates are lower than the average for all ages together. Furthermore, they are lower in the 65+ age group than in the 55-64 age group. Among women, rates are higher in the 55-64 age group but lower in the 65+ age group than the average for all ages for women combined.

Table 2: Standardised incidence rates of accidents at work resulting in over three days' absence (per 100,000 workers) in the EU-28 in 2013 (source: Eurostat, 2015e)

Gender	Age group		
	55-64	65+	All
Males	1,847	1,101	2,097
Females	1,062	824	961
All	1,559	990	1,662

When data on accidents and injuries at work are examined, a number of differences can be identified between age groups.

In 2011, the sectors in which fatal accidents occurred in high numbers among older workers were agriculture (25 %), sales (11 %) and transport (truck driving) (10 %), with the causes identified as road traffic accidents (18 %), homicides (13 %) and falls to a lower level (10 %).

Younger workers are more at risk of having an accident than older workers (Crawford *et al.*, 2009; Khanzode *et al.*, 2012; Salminen, 2004; Turner *et al.*, 2000; Yeomans, 2011), with those with less than one years' experience of work being most at risk (Khanzode *et al.*, 2012). Tenure or seniority in the job was also evaluated in the paper by Bande & Lopez-Mourelo (2014). It was found that workers with less than three months of experience were significantly more likely to sustain a severe or fatal injury than those employees who had been in the same job for longer (Bande & Lopez-Mourelo, 2014). The analysis suggested that, after one year, enough experience was attained to avoid workplace hazards related to inexperience ([2]). However, older workers are found to be more at risk of a severe or fatal accident than younger workers (Bande & Lopez-Mourelo, 2014; Crawford *et al.*, 2009; Khanzode *et al.*, 2012; Salminen, 2004; Yeomans, 2011). It was suggested by Salminen (2004) that this was the result of better impact tolerance in younger workers. Although this would affect the severity rather than the occurrence of an accident, most accident statistics record only those resulting in more than a certain number of days of absence, so non-lost time accidents or those resulting in only one or two days' lost time will not be included.

In the USA, the most frequent types of non-fatal injuries occurring in older workers (over 55) are sprains and strains, affecting over 2 million workers and making up one-third of all injuries (Personick & Windau, 1995, cited by Crawford *et al.*, 2009). Fractures, bruises and cuts made up a further 30 % of non-fatal injuries.

In the study previously mentioned, the most common reason stated for an injury was over-exertion (25 % of cases), with falls on the same level accounting for another 20 %. An analysis of Spanish accident statistics by Bande & Lopez-Mourelo (2014) identified that, for workers over 65 years of age, the causal events to which the accidents were attributed included 'bodily motion' ([3]) (42.1 %), handling of objects (22.4 %) and working with hand-held tools (11.9 %). The modes of injury within this dataset for those

([2]) There have been some suggestions that this 'new worker' effect accounts for at least some of the apparent increase in susceptibility to accidents of younger workers.

([3]) This phrase is used in accident reporting to indicate that the worker was moving at the time. It is usually associated with the worker walking into or being struck by an object.

over 65 years included acute overloading of the body (27.3 %), a fall (23.4 %), being struck by or colliding with something (17.5 %) and crashing into something (11.4 %). In their review of 36 papers, Farrow & Reynolds (2012) identified that hearing impairment increases the risk of accidents and injuries at work, specifically passive accidents and falls on the same level.

Yeomans (2011) looked at work accident figures in the United Kingdom and concluded that the industry and occupation of workers played a large part in the differing rates of non-fatal injury between younger and older workers. The review by Yeomans found little conclusive evidence that older workers have an increased risk of occupational accidents compared with younger workers, and pointed out that occupation was the major factor determining accident rates.

In summary, research on accidents and injuries in older workers has identified some patterns in relation to injuries to younger and older workers. Older workers are generally less likely to have occupational accidents than younger workers, but those that they have are likely to be more serious. The studies suggest that the lack of experience and knowledge of the workplace and workplace hazards of younger workers may put them more at risk than more experienced workers. However, the increased rate of fatal accidents in older workers is of major concern in relation to maintaining safe and healthy working lives. However, occupation is the dominant influence on the risk of injury, and measures to reduce risks in those sectors with high rates of accidents would benefit all workers in the sector.

- **Slips, trips and falls**

For slips, trips and falls in the workplace, there is limited evidence available in relation to ageing, with only three papers identified in this area (Hsiao & Simeonov, 2001; Kemmlert & Lundholm, 2001; Turner *et al.*, 2000). Kemmlert & Lundholm (2001) collated data relating to injury and occupation in Sweden. The analysis categorised people into two age groups: those under 45 and those over 45 years. The results identified that, for both males and females, there were a higher proportion of slip, trip and fall accidents in the 45 and over age group. Changes in balance control may be a contributory factor.

The paper also examined the causal events to which these accidents were attributed. These were found to include slip or mis-steps, slipping on snow, slips due to lack of orderliness (poor housekeeping) in the workplace, falling to a lower level, fainting or loss of balance, and actions during climbing (including slipping from a climbing device and the sliding or breaking of a ladder). The analysis did not find any significant differences between the two age groups in relation to causal events at the time of the accident.

The studies reviewed by Yeomans (2011) contain some evidence to suggest that older workers experience more slips, trips and falls than younger workers, but one study reviewed did not find a significant difference.

The paper by Hsiao & Simeonov (2001) presented a critical review of the prevention of falls from roofs. Within this paper, age is mentioned as a risk factor, and a correlation is found between falls and increasing age, but no further evidence is provided. The paper presents potential synergistic factors that are likely to contribute to increased postural instability, including visual exposure to height, moving visual scenes at height, poor visual contrasts, load handling, task complexity, use of medication and experience level. With the potential changes in balance with age (Crawford *et al.*, 2009; Harper & Marcus, 2006), it is possible that age is an additional risk factor within roofing work. Future research will need to identify if existing control measures are adequate for all ages involved in roofing work.

Comfortable, well-fitting safety footwear designed for the specific work environment can help correct poor posture or improve balance. Footwear can be adjusted with individual insoles, arch supports, etc. Yeomans (2011) identified that education in falls prevention could benefit workers.

- **Recovery time and work-related sickness absence**

Several authors have identified that older workers have poorer outcomes after workplace accidents, with a longer recovery time needed (Bande & Lopez-Mourel, 2014; Crawford *et al.*, 2009; Turner *et al.*, 2000). Farrow & Reynolds (2012) identified that sickness absence following workplace injury increased in duration with each additional decade of age. For example, those aged 20-24 years were absent for,

on average, five days for recovery, while those aged 65 years and over were, on average, absent for 18 days. The analysis carried out by Bande & Lopez-Mourel (2014) on Spanish occupational accidents found that the length of time of the sickness absence after an occupational accident increases with age. These data suggest that workers over 65 years generally need double the amount of time to recover compared with workers aged 16-24 years. The authors highlight the importance of the increased medical costs associated with such longer periods of absence, which has implications for the cost effectiveness of any preventive or protective measures taken.

However, despite this longer period of absence, Pransky (2005, cited by Crawford *et al*., 2009) identified that, although the absence from work may be longer for older workers after injury than for younger workers, there were no significant age-related differences in ability to perform their work duties upon returning to work after the sickness absence. While Yeomans (2011) cites some studies that suggest that long-term sickness absence is greater for older workers, this was not consistently found.

Regarding evidence of any differences in general levels of sickness absence between young and older workers, Yeomans (2011) stated that it is a complex issue, influenced by various factors including personal, social and occupational issues. The empirical evidence reviewed suggested that sickness absence is lower (a lower frequency) for older workers, as periods of short-term sickness absence are fewer than for younger workers.

Providing rehabilitation for all workers who have been injured should enhance the likelihood that they will return to work by improving fitness, strength and flexibility (Zuhosky *et al*., 2007, cited by Yeomans, 2011).

3.2.4 Risks associated with physical, biological and chemical hazards and related health problems

- **Noise and hearing loss**

Hearing loss is associated with a number of different occupational causes, including exposure to dusty environments, exposure to ototoxic chemicals and, of course, noise. The effects of age-related hearing loss can compound and accentuate the effects of noise-related losses. Only 7-15 % of the population are significantly affected by age-related hearing loss, so it should not be assumed that all older adults will affected by this (Irwin, 2000) and hearing aids can generally compensate for the loss (Yeomans, 2011). Age-related hearing impairment might have a negative impact on the discrimination of sounds or speech, having an impact on communication in the workplace and potentially hindering the ability to hear safety alarms. Furthermore, exposure to loud noise over a longer period will increase the cumulative dose, with adverse implications for noise-related hearing damage.

Hearing protection and noise assessment methodologies are well documented, as are suggested risk control measures, including reducing the noise at source using engineering controls and, where other risk reduction measures are not suitable or sufficient, providing suitable and adequate protection (e.g. EU-OSHA, 2005a, 2006). Protecting hearing throughout the working life is vital, especially for work in noisy environments where it is important to reduce the cumulative risk of noise-induced hearing loss and age-related hearing loss. Even if individuals feel that the damage has already been done, the use of control measures to avoid further damage to hearing should be continued. As mentioned, for individuals whose hearing has already been affected, the use of hearing aids may be helpful in reducing the work-related and social impacts of hearing loss (Benjamin & Wilson, 2005). Yeomans (2011) described some adjustments that can be made to the working environment to reduce performance decline as a result of hearing impairments such as minimising background noise and reverberation.

- **Exposure to ionising radiation**

There is limited information available in relation to the impact of radiation exposure at work on an ageing workforce. One paper (Bohle *et al.*, 2010) identified that exposure to ionising radiation for uranium process workers had a small effect on mortality. However, exposure after the age of 40 increased mortality by a factor of two or three for all cancers, all radiosensitive cancers and lung cancers. This

paper highlights the importance of recording health information at different working ages, as well as putting in place prevention measures to reduce radiation exposure throughout working life.

▪ Work in extreme temperatures

The reviews by Crawford *et al*. (2009) and Blatteis (2012) identified that, as we age, our responses to more extreme temperatures become less effective. This is the result of age-related changes in a number of different body systems, including the cardiovascular and respiratory systems, as well as the thermoregulatory system itself. Although age is not necessarily a good measure of our responses to extreme temperatures, the natural changes in physiological systems with age highlight the increased risk of poor thermal tolerance. As with other physiological systems, maintaining fitness levels can reduce the impact of age-related change; however, certain metabolic and skin changes are unavoidable. The decline in thermal tolerance is unlikely to be an issue in cold environments, but might be a problem in hot environments, especially for those already close to the lower boundary of an acceptable level of tolerance. For all workers, workwear for cold temperatures should be suitable for the environmental conditions, be comfortable, be adjustable/layered and have good thermal properties and airflow. Ways to reduce heat-related risks include engineering measures in indoor environments, access to drinking water, rest breaks out of the heat and education in the symptoms of heat-related illness.

With an ageing working population, the number of people with type 2 diabetes is likely to increase and thermoregulatory control is reduced in individuals with this disease (Wick *et al*., 2006, cited by Crawford *et al*., 2009). In addition, other medical conditions or their treatment (e.g. the administration of diuretics) can also adversely affect heat tolerance. These would usually be regarded as a contraindication for work in the heat (e.g. kidney disease). Thus, it is important that health surveillance or risk assessments in environments subject to extreme temperatures consider the impact of heat exposure on older workers.

▪ Light and deterioration in visual ability

In general, any decline in visual acuity with age can be compensated for with spectacles or simple modifications to the work, such as improved lighting (Yeomans, 2011). Declines in visual acuity can also lead to difficulties in driving at night (greater susceptibility to glare) (Kline *et al.*, 1992). Blue–yellow colour vision also deteriorates with age and, although these colours are seldom used in a safety context, this might be of importance in those jobs where a high degree of accuracy of colour rendition is required (Schieber, 2006).

Regular vision testing should identify many changes for which corrective appliances are suitable. Some safety glasses and goggles can be fitted with corrective lenses. Other face protection can be worn over normal corrective spectacles. Yeomans (2011) described some adjustments that can be made to the working environment to counteract some visual impairments, such window blinds to reduce glare, magnifying equipment and the increasing of text size on screens.

▪ Biological and chemical hazards

No review material has been found in relation to exposure to biological or chemical hazards and ageing. Safework Australia (2005), in a scoping document, identified that, despite the lack of research studies, older workers are considered more susceptible to the impact of chemical exposure because of their extended exposure duration and the build-up of chemicals, including mineral fibres, in the body. This could be accentuated by decreased functioning of the liver and kidneys as people age, resulting in slower rates of clearance. Similarly, although not extensively researched, skin thinning with age might influence the permeability of the skin to chemicals, increasing rates of absorption. Furthermore, the long latency period between exposure and disease could result in unintended exposures to substances not currently recognised as hazardous.

Many control strategies for the reduction of hazardous substances, including carcinogens and asthmagens, are already well documented. Consideration should also be given to the increased exposure duration that will occur through extending working lives. Continuing exposure at a constant level over a longer period of time will clearly result in a greater cumulative dose, which might be critical

for some chemicals. The impact of exposure at different life stages, such as exposure of young workers (Breslin *et al.*, 2006) or new exposures to older workers in later life, should also be considered. Research within an exposome ([4]) framework may help to answer some of these questions.

3.2.5 Risks of work-related musculoskeletal problems

- **Exposure to working conditions related to musculoskeletal disorders**

Work factors commonly related to the occurrence of work-related MSDs include repetitive movements, static and awkward postures, forceful movements and manual handling of heavy loads. Exposure to fast-paced work and vibrations increase the risk further. There is evidence suggesting that exposure to stressful work also increases the risk (EU-OSHA, 1999, 2010).

Work-related MSDs can develop from cumulative exposure over time. This raises various issues in relation to older workers, including the length of exposure over the work life course, from being a young worker onwards; the possibility of an increased length of exposure as a result of the rising official pension ages; and the physical capacity of older workers, including that of those over 65 years of age.

According to self-reporting by workers who took part in the sixth EWCS in 2015, exposure to painful and tiring positions remains significant, as does exposure to repetitive movements, with 43 % and 61 % of workers, respectively, reporting being exposed at least a quarter of the time. Exposure to repetitive hand or arm movements is by far the most prevalent hazard covered in the survey. Over 30 % of workers surveyed reported carrying or moving heavy loads at least a quarter of the time. While the reporting of these working conditions is slightly lower than in 2010, this may be because of the reduction in the types of jobs in which they are most prevalent, rather than the remaining jobs having become easier. On the other hand, workers reporting the lifting and moving of people, which is more common among women, has increased to around 10 % (Eurofound, 2015a). When the incidence of these working conditions is broken down by age, comparing under 35s with over 50s, there is some reduction to exposure for the over 50s compared with the under 35s for repetitive arm movements (63 % versus 58 %, respectively) and lifting and moving heavy loads (35 % versus 29 %, respectively). However, for the over 50s, exposure to both is still significant. For exposure to painful and tiring positions, the over 50s report being very slightly more exposed than the under 35s (42 % versus 43 %, respectively) and, for patient handling, the over 50s report being very slightly less exposed than the under 35s (10 % versus 9 %, respectively) (data extracted from the Eurofound data visualisation tool (2015c)).

Regarding physical working conditions and work-related MSDs, it needs to be borne in mind that, from the available data, it is not always possible to extract a clear cause–health effect relationship between working conditions and MSDs. For example, statistics on back pain do not differentiate between back pain arising from poor posture (e.g. sitting) and that associated with excessive external loads (e.g. manual handling) or other causes. Because of this lack of cohesive statistical data, this section will explore evidence relating to both the hazards (e.g. prolonged standing) and the musculoskeletal health consequences. It does not attempt to cover all of the risk factors relating to MSDs and focuses instead on those for which relevant research has been identified, although it also highlights some risk areas to which more attention could be given regarding sustainable work.

- **Work-related musculoskeletal disorders and age**

MSDs are recognised as a significant cause of work-related ill-health and sickness absence, although the cause of those MSDs in the workplace is not always clear (at least from collated statistics). They are an issue for employees in both the younger age group (under 25 years) and the older age group (over 55 years) (Okunribido & Wynn, 2010).

In general, the prevalence of MSDs increases with age, probably as part of the normal ageing process, although declining health does not necessarily mean a decline in job performance. Regarding work-related MSDs, there is no conclusive evidence that age by itself is a risk factor. Other factors, such as

([4]) The exposome can be defined as the measure of all the exposures of an individual in a lifetime and how those exposures relate to health (see http://www.cdc.gov/niosh/topics/exposome/).

work demands, may have a greater influence on the risk of developing work-related ill-health than age (Yeomans, 2011).

In one specific study carried out in France, Plouvier *et al*. (2011) explored the incidence of back pain around retirement age in relation to physical occupational exposures. The authors found that the prevalence of lower back pain for more than 30 days within the previous 12 months among those exposed to manual material handling and/or tiring postures progressively increased through the age groups 45-49, 50-54 and 55-59 (retirement at 60). Yeomans (2011) cited several studies that concluded that the increased prevalence of MSDs with age is most pronounced in workers involved in physically demanding jobs, irrespective of age. A study by Ilmarinen (2002, cited by Yeomans, 2011), found that an increased prevalence of MSDs with age was most pronounced among those who remained in the same occupation and who were exposed to physically demanding work. This suggests that a cumulative exposure factor is involved in addition to work demands. Okunribido & Wynn (2010) cited several studies that suggest that employees in physically demanding occupations and exposed to challenging tasks are more likely to report underlying health problems than those in sedentary occupations. While not a peer-reviewed study, an evaluation carried out by the French work insurance organisation Agence nationale pour l'amélioration des conditions de travail (Anact) — as part of an ergonomic workplace intervention in a printing company investigating the high rate of sickness absence from MSDs among the mainly female workers in the finishing department — found a clear link between extended working in this department involving highly repetitive work and awkward postures. Newly recruited male workers would quickly move on from this work, while the women tended to remain in the long term in the same work. It was concluded that the ergonomic improvements alone were not enough and measures were also needed to facilitate career progression among the female workforce (Chappert, 2013).

Three main changes occur with age that increase the risk of sustaining an MSD, namely a reduction in joint mobility, a reduction in muscle strength and the slowing of movement times (Okunribido & Wynn, 2010). Data on MSDs identify that both the prevalence and incidence of these changes increase with age (Crawford *et al.*, 2009; Okunribido & Wynn, 2010). Okunribido & Wynn (2010) identified that, although musculoskeletal capacity does decline with age, it is influenced by other factors including levels of habitual physical activity and the physical demands of the work. They suggested that older workers performing a specific task may have to work closer to the limits of their physical capabilities than their younger counterparts, which results in an increased risk of sustaining an MSD among this older age group. They further suggested that a mismatch between the demands of the work and the work ability of the individual is more of a factor than (chronological) age itself. Yeomans (2011) sums this up, stating that it is 'not the age of the worker that is the issue, but that the work or workplace is demanding more of the worker than the worker is capable of giving'.

When further examination is made of the impact of MSDs on sickness absence and time away from work, it is found that MSDs tend to be more severe in older workers. Sickness absence data in relation to MSDs show that, similarly to workplace accidents, younger workers are absent more often, but for shorter periods, than older workers, who are absent less often, but require longer periods for recovery and recuperation (Bevan *et al.*, 2007; Okunribido & Wynn, 2010). Among older workers, those with back injuries were associated with a reduced likelihood of returning to work compared with their younger colleagues (Turner *et al.*, 2000). It is possible that some of the exit from work seen in older workers is related to the demands of the work. Given the prevalence of chronic MSDs, both work related and non-work related, Summers *et al*. (2014) suggested that much more needs to be done to support individuals living with a chronic MSD who are either in work or planning to return to work in the future by both employers and external agencies. To tackle the huge cost of sickness absence in the EU from MSDs, Bevan (2013) proposed coordinated action between government departments, employers and clinicians to treat sufferers and to keep them in work.

The lifelong impact of musculoskeletal pain needs to be considered, as there are reports of schoolchildren reporting pain at earlier stages of life. In the work of Murphy *et al*. (2007), in a sample of 679 schoolchildren between the ages of 11 and 14 years, 27 % of the children reported neck pain, 18 % reported upper back pain and 22 % reported having lower back pain. The findings of research on school children raises the issue of young workers coming into the workplace with pre-existing musculoskeletal problems that have the potential to be exacerbated by work.

- **Risks associated with prolonged standing or sitting**

Excessive postural loads without external force being applied include those associated with inherently poor working postures (e.g. seated postures associated with poor ergonomics of office workstations or adverse postures associated with some industrial tasks) and those that present a risk because of extended exposure. Given the prevalence of work-related MSDs, a reduction of exposure to work-related risk factors would seem to be a priority in terms of the sustainability of work across the life course. While demanding work involving excessive postural loads with the application of external force, such as the manual handling of loads, has received some attention as regards sustainable work, non-inherently risky static postures, including prolonged standing and sitting, is one area that could be given more attention in relation to sustainable work.

Static standing postures are not inherently risky but, if sustained for long periods, can lead to muscle fatigue, discomfort and other consequences. Standing for long periods of time at work has been associated with a number of problems. Reviews suggest that prolonged standing can lead to lower back and leg pain, cardiovascular problems and more general fatigue and discomfort (Waters and Dick, 2015). Although there is no formal research currently available on problems of standing for long periods in relation to an ageing workforce, the association between age and the incidence of such problems means that they may be more of an issue among older workers.

WorkSafe Alberta (2006) make a number of recommendations in relation to standing at work, and, although they are not specifically addressed to older workers, they are of clear relevance for this group. These include:

- arranging for work to be carried out in a seated position when possible;
- ensuring there is the possibility to change posture or move if seating is not an option;
- ensuring the work is presented at an optimum height or angle to ensure that workers do not have to reach or stoop.

Remaining in static sitting postures is also not recommended for the musculoskeletal system. According to the German Federal Institute for Occupational Safety and Health (BAuA), an office worker alone spends 80,000 hours of his or her working life seated (BAuA, 2008b). It lists tension and pain in the shoulders and neck, back problems, and eye problems and headaches among the symptoms suffered by those who regularly work at a computer screen. In addition, for sitting, there is also a small but growing amount of evidence suggesting that there is a link between prolonged, uninterrupted periods of sitting and cardiovascular health risk factors, as well as other health problems such as type 2 diabetes (De Rezende *et al*., 2014; Dunstan *et al*., 2011). Ways of working have been changing dramatically with the introduction of display screen equipment and more sedentary working for many, so it is possible that prolonged exposure to this way of working over the life course could become more of an issue in the future for older workers.

BAuA (2008a, 2008b) advocates so-called dynamic sitting to promote postural changes, of which ergonomic seating is only one of the measures to take. In addition, BAuA advocates introducing ways of working to promote getting up and moving around, where possible, to limit long periods of continual sitting.

In summary, long periods of working in fixed postures is not recommended for workers of any age, and there will be risks associated with both short-term and long-term exposure to such working conditions. Where possible, work should be designed to allow workers to move around or change position. Appropriate work design contributes to making work sustainable, helping people to remain in the labour market. More research is needed in general on work and static postures and in relation to sustainable work.

- **Implications for the prevention of musculoskeletal disorders**

Prevention measures should be taken at all stages of working life to prevent the expected increase in MSDs in the ageing workforce. Measures to prevent risks from manual handling, repetitive work and static and awkward postures would benefit all workers. Based on a review of the literature, Yeomans (2011) suggested that accommodations that might benefit older workers in computer-based work

include taking frequent breaks or micro-breaks; ergonomics training on how to adjust and change their work environment, to reduce discomfort and enhance performance; and simple adjustments to computer screens and lighting, etc., for changes in vision. As previously mentioned, BAuA has recommended more dynamic sitting and moving about in the office.

Regarding the risk of MSDs in relation to physically demanding work, a worker's physical work capacity or ability should be used, rather than their age, to determine if they are capable of performing a specific job and to determine the risk of MSDs. Employers may need to provide additional support, including adjustments to the work (Okunribido & Wynn, 2010). It is suggested that evaluations of the risk of musculoskeletal problems should assess the whole load on the body caused by the various tasks that make up a job, for example the combination of repetitive tasks, static postures and manual handling of loads, rather than considering them separately, and that this is particularly relevant for assessing capacity in relation to work demands (EU-OSHA, 2008a). In any case, the actual work performed by the worker should be observed and assessed, taking a participatory approach involving workers.

3.2.6 Risks leading to physical and/or mental fatigue

Fatigue can be caused by issues both inside and outside the workplace and can ultimately have an impact on performance at work. Fatigue can be the result of sleep loss and/or work-related factors, such as prolonged exertion, machine-paced work, shift work (possibly associated with sleep loss) and complex and monotonous tasks (HSE, 2006). Fatigue has been associated with a deterioration in mental and physical capabilities, manifested as a reduction in reaction time, a decrease in information processing ability and a reduction in concentration.

Older workers experience a natural reduction in sleep length and earlier awakening (Costa and Di Milia, 2008). In addition, it is suggested that sleep quality deteriorates between the ages of 32 and 52 years (Foret *et al*., 1981, cited by Costa & Di Milia, 2008). Research suggests that health deterioration with age may be more pronounced in those that work in shifts, owing to the nature of the job and possibly connected to chronic fatigue and sleep issues (Harma, 1996, cited by Costa & Di Milia, 2008). Yeomans (2011) found conflicting evidence of a link between age, shift work and ill-health and Griffiths *et al*. (2009) suggested that only some older workers experience difficulties with shift work and need additional support or to cease working shifts.

It has been suggested that older nurses have a higher incidence of physical fatigue than younger nurses because of their work tasks and rotating shift schedules, and often feel that they are unable to work the shift patterns that they used to do (Moseley *et al.*, 2008).

Kiss *et al*. (2008, cited by Crawford *et al.*, 2009) and Yeomans (2011) found that those over the age of 45 years had a significantly greater need for recovery than those under 45, in particular among women. Devereux & Rydstedt (2009, cited by Crawford *et al.*, 2009) and Yeomans (2011) further reported that workers between the ages of 50 and 69 have a greater need for recovery from physically and psychologically demanding work than younger workers. They also suggested that working more than 42 hours per week and experiencing high psychological demands and physically demanding work also has an impact on the need for recovery, which highlights the importance of assessing and controlling work demands, especially for older workers.

The impact of fatigue and the need for recovery increase with age. However, any prevention measures for older workers should not simply assume that younger workers can take on the burden of work or different shift systems, as this will result in unsustainable work patterns and may increase the risk of burnout at a younger age. Making work less fatiguing would benefit all age groups of workers. However, according to workers' replies to the fifth EWCS, exposure to psychosocial risks tends to go hand in hand with exposure to physical risks (Parent-Thirion *et al*., 2012), and this double exposure has implications for the sustainability of their work. The correct implementation of EU legislation on recovery time between work shifts is also essential for all age groups.

3.2.7 Risks arising from psychosocial hazards

- **Psychosocial risks ([5])**

Guarinoni *et al.* (2013) identified that, as ageing is associated with a natural deterioration of physical and mental capacities, it could lead to a reduced resilience and tolerance to stressful situations, which would put older workers at greater risk of developing stress-related conditions. However, Hansson *et al.* (2001) suggested that older people constitute a highly heterogeneous population, with considerable variability in how they react to psychosocial risks. This variability demonstrates the complex relationship between ageing and stress processes (Hansson *et al*., 1997, cited by Hansson *et al*., 2001).

Psychosocial risks in the workplace can be divided into two areas. The first group consists of the risks that are intrinsic to the job, such as time or workload pressures. The second group covers the impact of the organisational and social context of the job, such as ambiguity of an individual's role within an organisation or the resources made available to the worker, such as support from peers and superiors (Hansson *et al*., 2001; Kahn *et al*., 1992, cited by Hansson *et al.*, 2001). According to replies to the fifth EWCS, psychosocial risks that have a negative impact on workers' health and well-being include high demands and work intensity, emotional demands, lack of autonomy, ethical conflicts and poor social relationships, as well as job and work insecurity. In addition, long working hours were associated with high levels of work intensity and, as mentioned, exposure to psychosocial risks tends to go hand in hand with exposure to physical risks (Parent-Thirion *et al*., 2012).

Osipow & Doty (1985, cited by Hansson *et al.*, 2001) showed that the causes of work-related stress for older workers were different from those of younger workers. In contrast to younger workers, older workers, with their levels of experience and increased status in the workplace, experience stress from the responsibility they have for other people's work and from the level of their workload, rather than from the physical work environment. Meltzer (1981, cited by Hansson *et al*., 2001) found that lawyers over 60 years reported less occupational stress than their younger counterparts, which seemed to be related to them having more autonomy and control in their work than younger lawyers.

There is also evidence that older workers experience a lack of training opportunities compared with younger workers (e.g. Eurofound, 2015a), which can result in them experiencing difficulties in keeping up with changes in the workplace or lead them to feel isolated, either as a result of the changes or because of the lack of training. In some cases, this may have a negative impact on their career development and can be a source of stress for these workers.

The current economic climate has also been suggested as a cause of stress for older workers, as there is increased financial pressure on workers to work longer than they would have done in the past (Guarinoni *et al*., 2013). Those having trouble coping with work because of their age are more likely to find that financial constraints, such as increased debt or less generous pension provisions, make it harder for them to choose to stop working than would have been the case for their counterparts in previous decades. As a result, those workers that see themselves as 'forced' to remain at work because of such constraints may have an increased sense of resentment and job dissatisfaction, which can lead to further stress. In this regard, social inequalities play an important role, as older workers with greater financial resources may choose to stop working where others cannot because of financial reasons. While anecdotal evidence is available to support this assertion, there are no data currently available.

Griffiths *et al.* (2009) presented evidence to suggest that stress is linked to the occurrence of chronic diseases in older workers (Salonen *et al*., 2008, cited by Griffiths *et al*., 2009). Research in this area has mainly focused on cardiovascular conditions and MSDs, for which there is strong evidence of an association between these conditions and exposure to stressful situations (Ritvanin *et al*., 2006, cited by Griffiths *et al*., 2009).

([5]) Technically, these are hazards, but the term 'psychosocial risks' is widely used to describe them and will used be here to avoid confusion.

- **Age differences in coping strategies**

Blythe *et al.* (2008, cited by Griffiths *et al*., 2009) presented evidence that both older and younger workers are less likely to report stress if they have higher levels of job satisfaction. This is challenged by the idea that older workers are more influenced by organisational politics, which ultimately have a negative impact on job satisfaction and through this have the potential to increase stress (Miller *et al*., 2008, cited by Griffiths *et al*., 2009).

Baltes & Baltes (1990, cited by Hansson *et al.*, 2001) hypothesised that the selective optimisation with compensation (SOC) model may explain why older workers report lower levels of stress. The model is based on selection (identifying priorities), optimisation (spending time on important areas) and compensation (compensating for non-reversible age-related change) concepts. It suggests that, with increasing age and a concomitant reduction in work capacity or reduction in adaptive reserves, individuals need to specialise more on particular areas of expertise, optimise their performance in those tasks and consider compensation strategies (delegation or work distribution) to aid them in successful completion of their work.

Work carried out by Abraham & Hansson (1995, cited by Hansson *et al*., 2001) found that workers aged 49 to 69 years that used the SOC model strategies experienced greater success in maintaining the competencies they required for their work. However, the effect among younger workers of using such strategies was small. It is apparent that, to effectively employ such strategies, individuals have to have sufficient workplace control, and such control is more likely to be available to older workers.

- **Age and stress**

Mild or moderate psychological and emotional symptoms are very common in the working population across all age groups. Generally, the evidence suggests that work-related stress, anxiety and depression increase with age and then decrease after the age of 55 (Yeomans, 2011).

Remondet & Hansson (1991, cited by Hansson *et al*., 2001) compared older (54 to 72 years) and younger (30 to 53 years) workers' experiences of their jobs and found that older workers reported fewer stress-related occupational health problems. These results are supported by the Labour Force Survey, which shows that, while depression and anxiety are the second most commonly reported work-related illnesses among all workers, workers aged between 35 and 54 years are the age group most likely to report stress as their most serious work-related health problem, followed by those aged 34 years and younger. The age group least likely to report stress as their most serious problem are those aged 55 years and over. However, care should be taken in interpreting this, because of the serious limitations of these data, referred to in section 2. This reduction in the reporting of stress in older age groups might mean that other health problems (e.g. MSDs) have attained a greater significance for these age groups than stress-related health problems, but it does not necessarily mean that an actual reduction in stress has been experienced by older age groups. Nevertheless, Griffiths *et al*. (2009) cited several large-scale studies that also suggested that work-related stress increases with age, until 50 to 55 years, and then decreases towards retirement.

However, if this is a genuine effect among older workers, one reason might be due to a 'healthy worker effect', as those that have 'burned out' because of long exposure to psychosocial risks may have left the workforce entirely or changed employer (Griffiths *et al*., 2009). The Whitehall Study II (Mein et. al., 2000, cited by Griffiths *et al*., 2009), a longitudinal study of 10,000 London civil servants aged between 35 and 44, suggested that employees who have poorer mental health are more likely to retire earlier than those with good mental health. It was suggested that those that remain in work, known as 'survivors', may have personality traits that have adapted to the psychosocial risks at work (Landa *et al*., 2008, cited by Griffiths *et al*., 2009). It was also suggested that these 'survivors' may work in higher level positions, giving them more control over their workload (Jorm *et al*., 2005, cited by Griffiths *et al*., 2009). It is widely recognised that the degree of personal control is a strong modifier of the effects of other psychosocial risks. As a result, older workers who have less control over their work are likely to have more difficulties in coping with this fact, which results in feelings of stress (Belin *et al.*, 2011). The issue of control over work was also identified by the Whitehall study. It identified work characteristics (low levels of control, variety, skills use; work pace; support) and low levels of job satisfaction to be among the risk factors for high rates of sickness absence (Barham and Leonard, 2002, cited by Yeomans, 2011).

On the other hand, there is also evidence that continuing to work is associated with increased physical health and psychological well-being compared with being out of work (Waddell and Burton, 2006, cited by Yeomans, 2011; Griffiths *et al*., 2009). Nevertheless, according to Griffiths *et al*. (2009), stress is only one factor affecting older workers' decision to leave the workforce, alongside other dissatisfactions with working conditions.

The findings of the sixth EWCS point to a significant proportion of workers who are confronted with a high level of work demands (Eurofound, 2015a). Therefore it is important that measures are taken to control work-related stress for the sustainability of work and the benefit of workers of all ages.

- **Social support**

Social support plays a dual role in relation to psychosocial risks in the workplace. The absence of adequate social support is recognised as a risk factor, potentially leading to stress-related illness. Conversely, good social support can act as a buffer against the effects of other psychosocial risks, such as high work demands (EU-OSHA, 2014a). Griffiths *et al*. (2009) identified a link between practical and emotional support from social networks and enhanced physical and psychological well-being. Their review suggests that social support provides individuals with a buffer against stressful situations, thereby reducing the impact of psychosocial risks. In addition to supervisors/line managers, research shows that colleagues are also an important source of social support, particularly for older workers (Robson & Hansson, 2007, cited by Griffiths *et al*., 2009). Outside the workplace, good social support results in a sense of belonging and assistance, which again provides a protective buffer against negative situations. These feelings help an individual to cope better and to have an increased sense of control.

In the context of extending working lives, good social support at work can also contribute to a reduced likelihood of early retirement (Ilmarinen *et al*., 1991, cited by Griffiths *et al*., 2009). It has been suggested that the positive effect of social support within the workplace on older workers relies on the supervisor/line manager knowing about the needs of ageing workers, and managing such workers in an age-appropriate manner. Griffiths *et al.* (2009) suggested three methods of improving social support at the workplace for older workers:

- improving management's understanding of age-related issues;
- encouraging a supportive relationship between supervisors/line managers and older workers;
- encouraging a supportive social context within the workplace.

3.2.8 Impact of night work and shift work

There is evidence that shift work, and particularly some types of rotation, is detrimental to health across all age groups (Weyman *et al*., 2013). The tolerance for both night and shift work by older workers has been examined by a number of authors since 2000.

As people age, there are a number of physiological changes that have the potential to affect their ability to work different shifts. Costa & Di Milia (2008) suggested that intolerance to night and shift work were associated with an increase in the likelihood of internal de-synchronisation, slower circadian adjustment, reduced sleep duration and increased wakefulness, and an increased likelihood of earlier waking ('morningness') with age. Both shift work and night work have been associated with the occurrence of chronic diseases, including cardiovascular diseases and intestinal problems. Night work in particular has also been linked to breast cancer (Harma & Kandolin, 2001).

Saksvik *et al.* (2011) carried out a systematic review of individual differences in tolerance to shift work. The review included 60 papers, 10 of which were longitudinal studies. In relation to ageing and shift work, most of the reviewed studies found that tolerance to shift work was associated with younger age groups, with the critical age for tolerance being between 40 and 50 years. However, some longitudinal studies included in the review found that older workers were able to tolerate shift work relatively well. It was hypothesised within the review that this apparent anomaly was due to a 'healthy shift worker effect', where individuals who are able to tolerate shift work continue in this type of work to an older age.

Folkard (2008) examined the relationship between shift work, occupational safety and ageing. The review found that no research has focused specifically on the combined effects of age and shift work on injuries and accidents. Any conclusions that may be reached are based on age as a secondary outcome measure. This indirect evidence suggests that injury rates are generally higher on night shifts than on day shifts and that they increase as the number of nights worked sequentially increases. Taking age into consideration, there is also evidence that performance may not be maintained over the period of a night shift and over a period of sequential night shifts. However, this has not been measured directly and high-quality epidemiological research is required to explore this issue further.

Research investigating the relationship between shift work and the cognitive functioning of older workers has shown mixed results. Using neurological tests, Rouch *et al.* (2005, cited by Harper & Marcus, 2006) concluded that shift work has a negative effect on the cognitive function of memory. More recently Harma *et al*. (2006, cited by Harper & Marcus, 2006) found that a fast-forward rotating shift system improved psychological performance and alertness on night shifts, apparently contradicting the earlier result. It is likely that the differences in results arise from differences between what is being measured (and how and under what circumstances it is being measured). The conclusion would seem to be that the cognitive effects of shift work among older workers are complex. It has been shown that shift work can also have a positive or a negative impact on exposure to psychosocial risks, depending on the detailed pattern of the shift work and the preferences and needs of the individual. For example, work organisation can result in consecutive free days (usually positive) or having to work weekends (usually negative) (Harma & Kandolin, 2001).

Costa & Sartori (2007) found that Work Ability Index (WAI) ([6]) scores reduced with age for those working shifts, but this reduction occurred earlier in female workers (from the age of 35 years) than in men (from the age of 45). The authors suggested that this may be a result of the dual roles of women at work and at home.

In her review of age and employment, Yeomans (2011) found conflicting evidence regarding the possible link between age, shift work and ill-health. She concluded that this may be because of large differences in the ability of older individuals to cope with shift work and night work and because of the healthy worker effect. She also cited a number of studies that suggested that older workers have fewer problems with morning shifts than younger shift workers. Weyman *et al*. (2013) also found mixed evidence regarding shift working being more detrimental for older workers, but also pointed out that shift working practices appeared to be an important influence on employees' intention to leave the healthcare sector. Griffiths *et al*. (2009) found evidence that some older workers, but not all, have difficulties with afternoon and night shifts and may need additional support or a transfer to non-shift work. They also concluded that the cumulative effect of the number of years spent working shifts is more important than age in predicting ill-health effects. According to the sixth EWCS, younger workers are more exposed to shift work than older workers (Eurofound, 2015a), suggesting that there may be some adjustment taking place in the workplace for the general differences in shift tolerance between older workers and younger workers.

Based on a review of the literature, Yeomans (2011) suggests the following approach at the workplace: a flexible and individually tailored approach for those reporting difficulties, if possible including a transfer to the individual worker's preferred shift pattern, which may include avoiding night shifts and a transfer to early morning or day work; providing more opportunities for breaks; arranging more frequent health checks; providing older workers with increased control over work; and providing increased social support and offering counselling advice on health aspects, stress management and exercise.

By working night shifts sequentially, the risk of accidents for all workers increases. This would suggest that rotating shifts would benefit all workers. A reduction in the length of night shifts should also be encouraged to improve recovery in older workers and reduce the risk of burnout in younger workers.

Finally, more attention is needed on the possible link between the cumulative effect of working night shifts and breast cancer.

([6]) The WAI is a measure of the perceived work ability of individuals. For more information, see section 4.1.2.

4 Creating sustainable work along the life course

4.1 Sustainable work and models of the interactions between ageing and work

Key findings

- *The models of sustainable work* present the various complex and interacting elements that can influence the sustainability of work and the work ability of individuals and, therefore, the continuation or early exit from work of those individuals. By improving understanding in this way, they can help to improve policy and interventions regarding the retention of older workers at work.
- *In relation to OSH, sustainable work consists of two main elements, both of which are covered by the European legal framework on OSH*: (1) ensuring work does not damage physical or mental health across the life course, by controlling risks to all workers (generic measures); and (2) taking additional steps if and when necessary to protect any particularly vulnerable groups or individuals.
- '*Work ability' refers to an individual's resources (for example, physical capacity, attitudes, experience) in relation to work demands (for example, work content, work environment, work culture)*. The work ability concept has been incorporated into a self-assessment tool, the WAI, which can assist with the early identification of risks to individual workers in order to counteract them.
- As depicted in the conceptual models relating to sustainable work, *improving the retention of older workers is not just a function of maintaining their health and capacity and providing quality working conditions; it is also essential to take other inter-related factors into account*, including motivation, learning opportunities and broader socio-political and institutional factors, such as income distribution, and pension and tax regimes.
  As suggested by the models, *an effective OSH system is needed to support the approach to sustainable work* of combining improved protection for all workers with measures for individuals at greater risk as and when necessary.

4.1.1 Introduction

Section 1.2 briefly introduced the connected concepts of work ability, sustainable work and the life-course approach. They have also been addressed to some extent in relation to the findings in section 3 on age-related changes and the impact of work along the life course. These concepts can be used to provide an integrated and systematic approach to considering the ageing workforce and the implications for workplace safety and health. This section presents in greater detail some of the current thinking on sustainable work and OSH measures, as well as some of the models developed to better understand the interactions between ageing and work.

The concept of sustainable work, in the European employment context, is seen as enabling more people to join the labour market and enabling those people to stay in the labour market for longer. The changes to workers as they age, the changes to health over the life course from exposure to hazards and the implications of these changes for performance and workplace safety and health can be seen as having the potential to form barriers to sustainable work, as they have the potential to keep (older) people out of the labour market or to prevent them from staying in work.

Eurofound has identified the conditions that make work sustainable over a lifetime and are therefore likely to promote a longer working life. The concept of work sustainability takes into account the simultaneous — and partly contradictory — evolution of working conditions and of the demography of the active population. It considers job quality for older workers and also how job quality affects all age groups. From its research, Eurofound (2012a) identified five core dimensions of work that contribute to work sustainability:

- working conditions;

- physical and psychological health;
- the expressive dimension of work;
- reconciliation of working and non-working time (work–life balance);
- socio-economic conditions.

The reasons that explain why older workers remain at work relate not only to the elements considered in the present study, but also to national socio-political and institutional models, covering factors such as income distribution, and pension and tax regimes.

When sustainable work is considered from an OSH viewpoint, it consists of two main elements, both of which are covered in the European legal framework on safety and health at work. These are:

- ensuring that work does not damage health across the life course, by controlling risks to all workers (generic measures);
- taking additional steps where necessary to ensure that any particularly sensitive groups (vulnerable workers) are protected (may relate to both age and disability/chronic health problems).

Various models have been put forward to help our understanding of the multifaceted nature of sustainable work, both inside and outside the workplace. While they have in common a connection to sustainable work, they each approach the issue from a different perspective and provide different insights into issues relating to sustainable work and wider social spheres. Applying the models to the issues surrounding work and ageing can enhance our understanding of the inter-relationships between the different elements of the models. This understanding can then be used to develop interventions, either in the workplace or in the wider social sphere incorporated into some of the models.

The work ability concept provides an example. Here, it is not just the individual and his or her capacities that is considered, but also the wider context of the workplace and the work environment, as well as the work community, organisation and lifelong learning.

Each of the models chosen for inclusion in the review was selected for its relationship to OSH. For example, a particular model may show where OSH needs to interact more closely with workplace health promotion or reflect the interaction between human resources and age management in the work environment. The models have been developed by researchers from national OSH institutes in which considerable research on the ageing workforce has been conducted.

As suggested by the models, in relation to external factors, the effectiveness of the OSH system is a factor influencing working conditions and therefore sustainable work and the limitation of early exit from the workforce. Legal and enforcement measures are one aspect of OSH systems, but also of crucial importance are the existence, effectiveness and extent of access to OSH services to enterprises to support them in addressing OSH issues (Takala *et al*., 2009). To achieve sustainable work, enterprises need to combine improved protection for all workers with measures for individuals at greater risk, as and when necessary. OSH systems will be addressed again in section 5, ‘Discussion and conclusions’.

4.1.2 The work ability concept

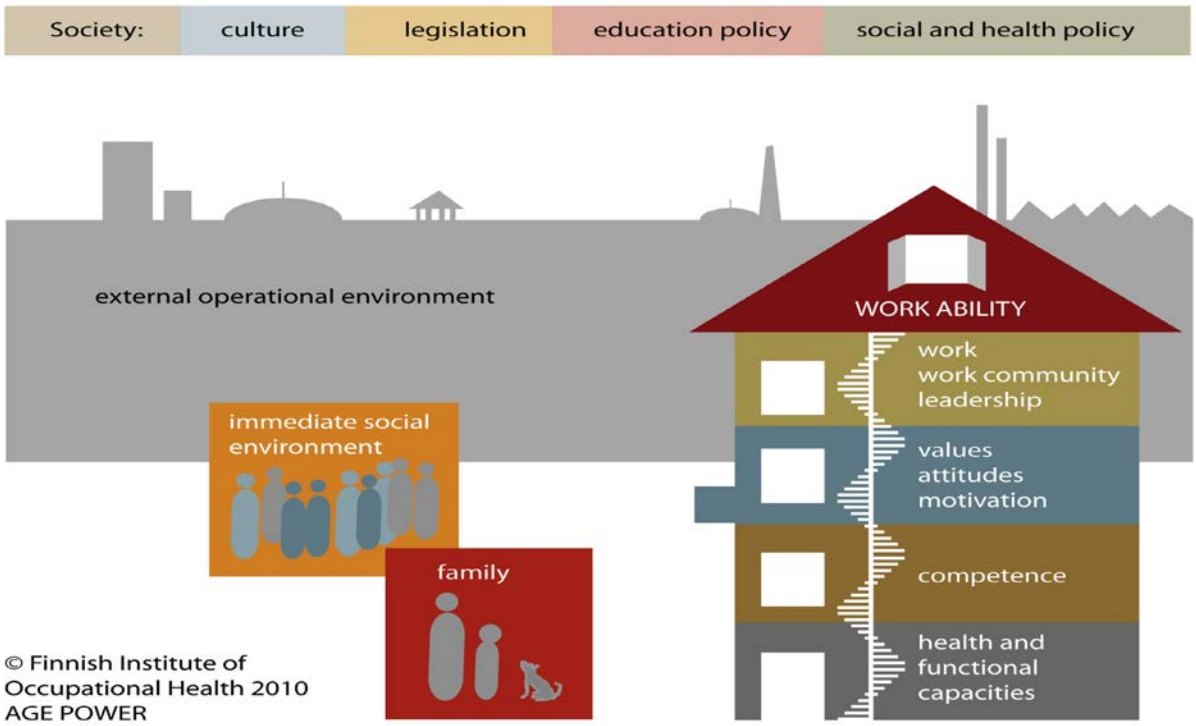
The concept of work ability was developed in Finland in the 1980s to try to address some of the issues related to demographic change and the need to extend working life (van den Berg *et al.*, 2009). According to Professor Ilmarinen, the creator of the concept, ‘work ability is the sum of individual and work-related factors. The different factors of work ability change dynamically with age. This approach emphasises the importance of the work environment, work content and the work community in addition to the resources of the individual workers as factors comprising work ability’ (Ilmarinen, 1999).

In 2001, Ilmarinen described the concept as putting an emphasis on individual work ability as a process of human resources in relation to work. Human resources were described in terms of health and functional capacities (physical, mental and social); education and competence; values and attitudes; and motivation. The work ability concept relates this set of individual factors to work demands (physical and mental), the work community and management, and the work environment (Ilmarinen, 2001a) and

is, thus, composed of the individual's resources and the demands of the work. As individuals change with age, the individual's resources also change, which can translate into a reduction in physical capacity with age, but also into an enhanced work ability because of acquired skills and experience. According to Illmarinen, work ability is therefore 'the foundation of employability and employment. Employability can be improved with different services and support systems, work and retirement legislation and changes in values and attitudes' (Ilmarinan, 2001b).

The more recent model, reflected in Figure 5, widens the description of work management to include factors such as leadership. The quality of leadership provided to the individual could potentially have a significant impact on the work demands experienced by the individual. The model also encapsulates how work ability can be influenced by other external factors, such as the operational and immediate social environment, family and wider society in terms of culture, legislation and policy.

Figure 5: Model of work ability (FIOH)



Building on this model, the WAI is a tool that provides a measure of the perceived work ability of individuals (Morschhäuser & Sochert, 2006; Tuomi *et al*., 1998). Having been tested as part of an 11-year continuous Finnish study (Morschhäuser & Sochert, 2006), this is now a widely used and accepted measurement tool that is available in 21 languages. The index and adaptations of it are being used in various countries, including Germany and Austria. The tool is a structured questionnaire or interview that can be used as part of an occupational health assessment at an individual level, or as part of larger studies across different departments within an organisation. The tool asks the individual to estimate current and future levels of work ability, doctor-diagnosed illnesses, sickness absence over the previous year and the perceived impact of deterioration in health and mental abilities on an individual's performance. It aims to identify health risks for employees and the risk of early retirement with the aim of counteracting these risks.

van den Berg *et al.* (2010) carried out a systematic review of factors that influenced work ability, examining 20 studies in which the index had been used and in which quantitative data were available on the determinants of work ability. The review identified that individual factors associated with poor work ability included increasing age, obesity, lack of physical activity in free time, poor physical working

environment, high physical workload and poor musculoskeletal capacity. In relation to psychosocial factors, a lower WAI score was associated with a lack of autonomy and high mental work demands. The findings suggest that improving work ability may require not only workplace changes (including not working extended hours), but also lifestyle changes, such as increasing physical activity outside the workplace.

While the work ability model is holistic, Weyman *et al*. (2013) are concerned that work ability assessment, although a good starting point, would be limited if it meant that intervention was restricted to a focus on individual (employee) assessment and bespoke solutions. They stated that 'The perspective on intervention and change needs to extend beyond individuals, to a more holistic perspective on systems of work and the configuration of work, orientated around sustaining older employment.'

4.1.3 Model to monitor sustainable employability

As part of its ongoing research into ageing and work, the Netherlands Organisation for Applied Scientific Research (TNO) developed a model to evaluate sustainable employability. When introducing the model, the European Observatory of Working Life described sustainable employability as 'the capability of employees to participate in a healthy, vital and productive way in paid work until they are eligible for a pension'. The model (shown in Figure 6) encompasses the different levels of policy and governance, from governments to collective labour agreements signed by organisations and human resources (HR) and OSH services. It also examines employee characteristics and their ability to cope with change, but considers this in the context of the characteristics of the work and future changes in work.

The model shares some features with the work ability model (in particular, it includes characteristics of the individual worker and characteristics of the work). However, it incorporates in more detail some of the wider societal influences, such as the role of the company (HR and OSH services) and of government policies. This helps to provide an increased understanding of the inter-relationship between the employee and his or her work and employment context. In a further difference from the work ability concept (which largely reflects the current situation), the inclusion of changes in work, and the abilities of the individual to cope with those changes, provide a progression from current employability to sustainable employability.

Figure 6: Model for monitoring sustainable employability for policy purposes (TNO, 2012)

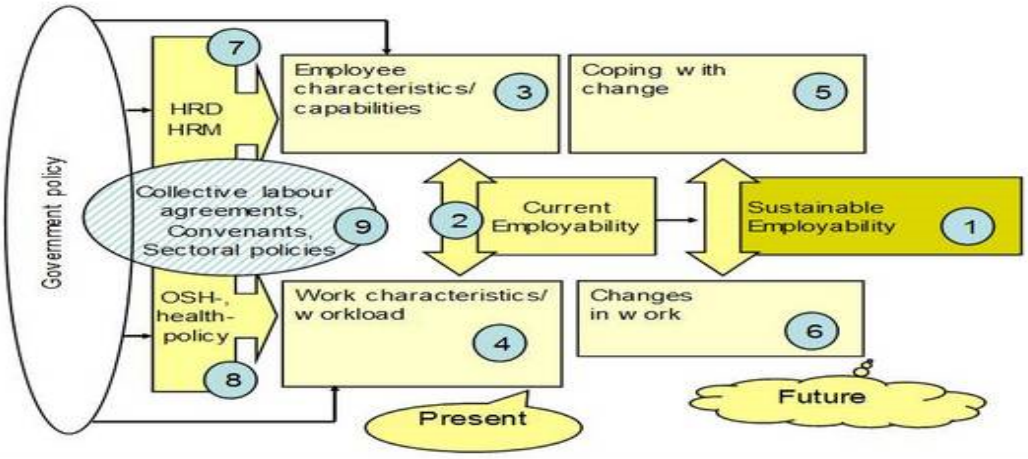


Figure note: HRD refers to human resource development; HRM refers to human resource development.

4.1.4 Conceptual framework on work, age, health and work participation

The conceptual framework on work, age, health and work participation of Peter & Hasselhorn (2013) provides a different insight into the individual worker and the factors that can influence his or her participation in work (see Figure 7). This model visualises the role of work and health within the context of (voluntary) early retirement. The model explains the participation of older people in work as a result of complex associations between factors such as the working environment, socio-economic status, lifestyle and health, and work ability and work motivation (also associated with domestic domain). Health is seen as a variable that indirectly influences if employees leave employment, while the immediate decision to leave employment is seen as being due to work motivation and work ability. These two factors may require intervention activities different from those needed to improve health. The model has been developed and is being tested as part of the German Iida cohort study (Hasselhorn *et al*., 2014).

In an extension to the model (options), the questions 'can I work?' and 'do I want to work?' are supplemented by the question 'do I need to work?'. This incorporates into the model factors such as the impact of financial concerns and of legislation, which may place restrictions on individuals wanting to take early retirement. The model suggests that both work ability and motivation can be affected by health.

The model provides for four core elements in early retirement decisions:

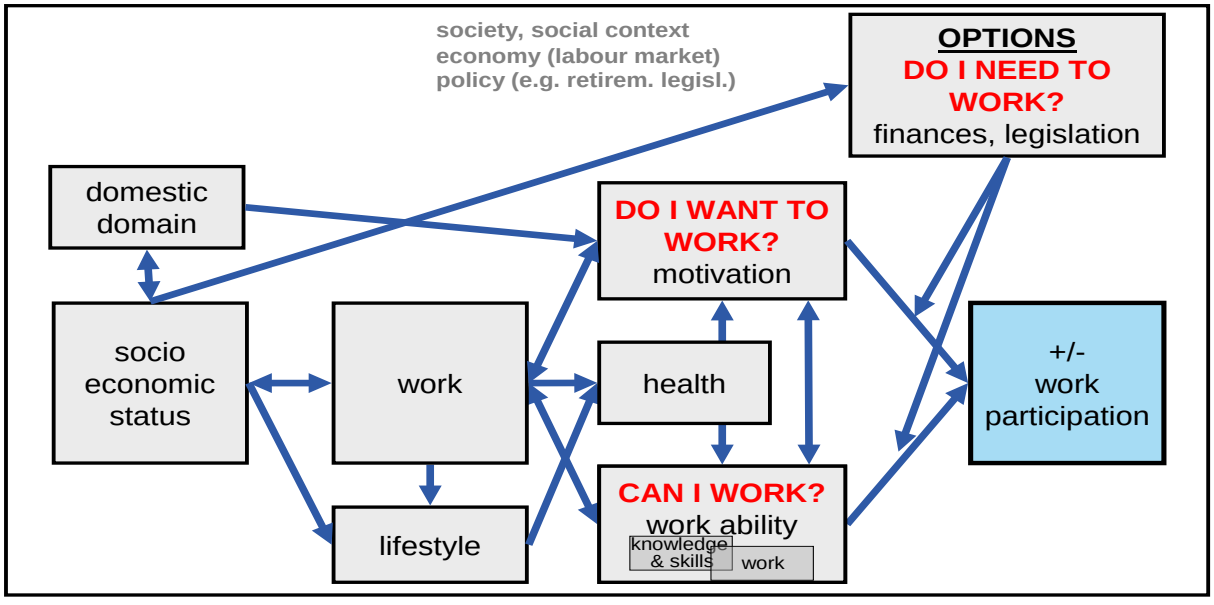
a) Complexity
   - (Early) Retirement (or non-retirement) decisions can be based on a number of fundamentally different domains.
   - Causal complexity: the retirement decision (or non-decision) is usually the result of complex mutual influences of different domains.

b) Process-type nature
   - Retirement can be regarded as a *process*, not an *on/off event*.

c) Individuality
   - Early 'voluntary' retirement is highly case specific and unique. It is thus a very 'individual' action and experience.

d) Structure (e.g. regulations, retirement legislation, social background)
   - Even if early retirement has a strong 'individual' component, it is simultaneously embedded in influential societal structures.

Figure 7: Conceptual framework on work, age, health and work participation (Peter & Hasselhorn, 2013, modified)

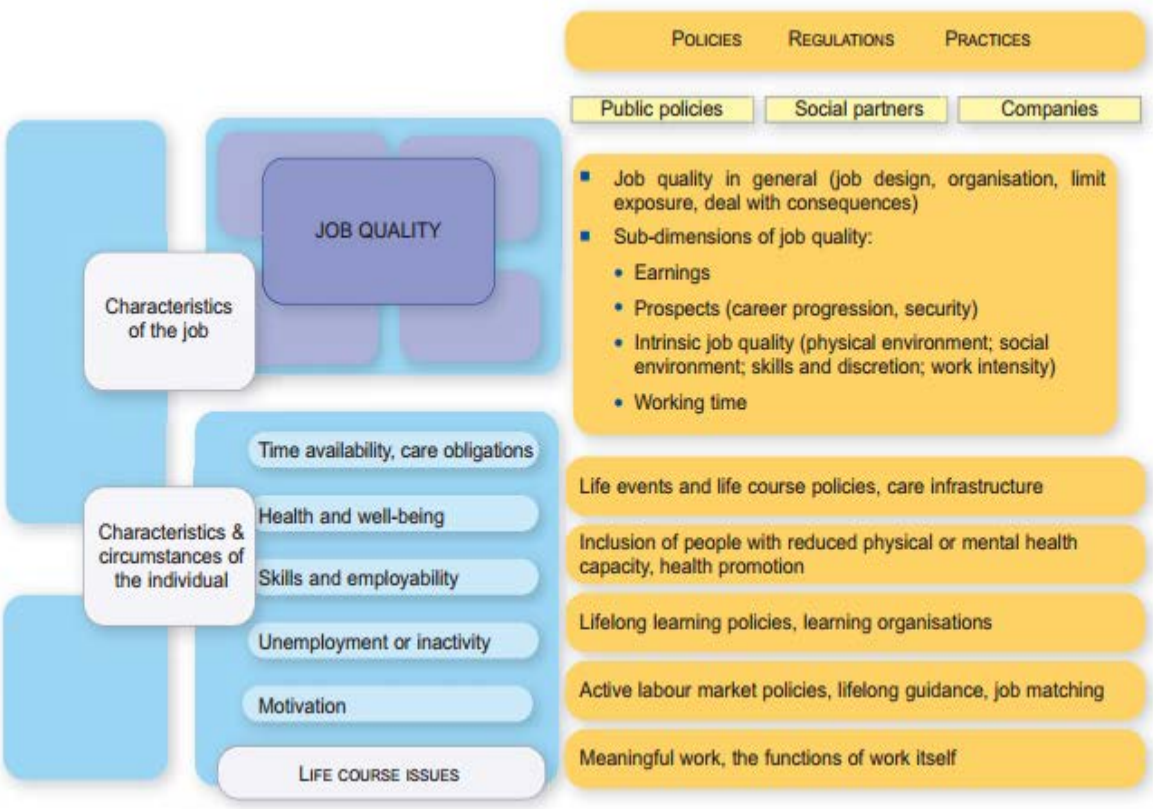


4.1.5 Schema for understanding the domains encompassed by sustainable work

Eurofound's model (Figure 8) aims to address the fit between two domains in order to understand how work is to be sustainable over the life course: (1) the characteristics of the job and the work environment and (2) the individual, specifically his or her characteristics and circumstances (Eurofound, 2015d).

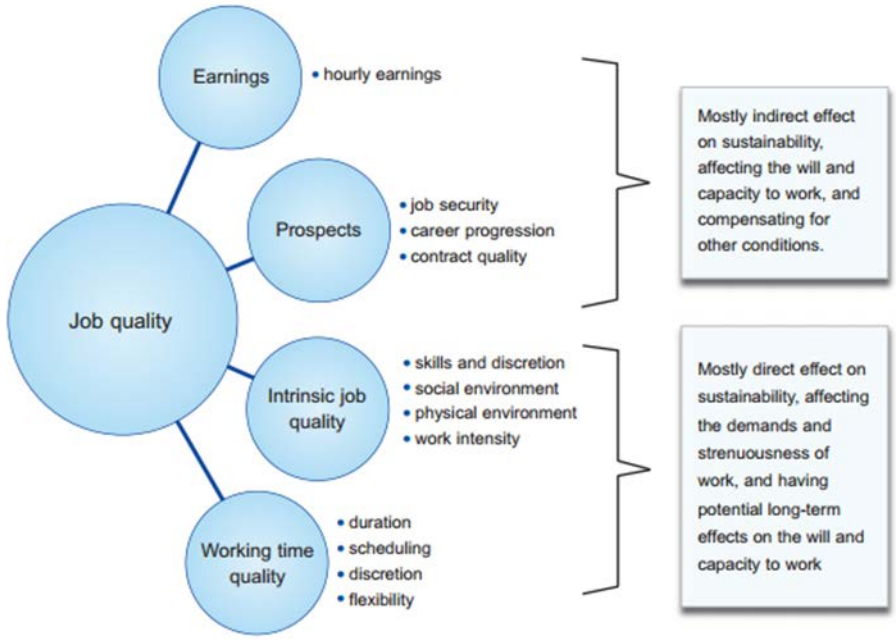
The characteristics of the job domain are relevant to workers currently employed and focus on job quality and working conditions over the life course. The characteristics and circumstances of the individual determine their availability for work. Both the characteristics of the job and the circumstances of the individual are influenced by a set of policies, regulations and practices, incorporated into the model.

Figure 8: Schema for understanding the domains encompassed by sustainable work (Eurofound, 2015d)



Within the schema in Figure 8, the most direct and obvious determinant of the sustainability of work is the characteristics of the job. Eurofound has expanded this area into a model for job quality, Figure 7, which identifies the aspects of a job that have the most impact on the well-being of workers and hence the sustainability of work. The model includes four dimensions of job quality: earnings, prospects, intrinsic job quality and working time quality (Eurofound, 2015d).

Figure 9 Model for job quality (Eurofound, 2015d)



4.2 What occupational safety and health measures can be considered to mitigate any potentially adverse safety and health effects and to promote sustainable work along the life course?

Key findings

- OSH measures to make work easier for all and workplace accommodations to allow workers with decline in health and performance to remain in work are often very simple.
- A comprehensive approach to age management in the workplace, to promote sustainable work and counter the effects of ageing, includes OSH, health promotion and HR measures.
- Risk assessment can support sustainable working as a means of identifying risk prevention measures to improve working conditions for the whole workforce or to identifying measures for specific groups or individuals. Work ability evaluation can be used as part of risk assessment. OSH aspects of age management can be accommodated within the normal workplace risk assessment and management process.
- Health surveillance monitoring over time and access to occupational health services are issues that need to be addressed, particularly for temporary workers and small businesses.
- Ergonomics has an important role to play in reducing the demands of work for all workers and making specific adjustments for groups of workers or individuals.
- Workplace health promotion interventions should be age appropriate, gender appropriate and inclusive of all age groups.
- Older workers can often benefit from appropriate flexible working arrangements, which allow them to accommodate other activities into their lives, such as responsibilities as carers, or to facilitate working with health problems. Social policy also influences whether or not workers can combine caring responsibilities and work.
- *Other measures* include maintaining up-to-date skills and knowledge, with training methods adapted to different age groups, and viewing older workers as an asset and developing their roles, for example through training and mentoring of younger, less experienced workers.

- The *prevention of injury and ill-health in younger workers* is an essential part of a sustainable work approach. The promotion of 'healthy schools' and risk education in schools is also part of a lifelong approach.
- *Rehabilitation* should be focused on staying in work, and early interventions are crucial. Rehabilitation programmes should be interdisciplinary. Simple workplace accommodations can often allow workers with chronic diseases to remain in work. More needs to be done to support individuals living with chronic MSDs who are either in work or planning to return to work in the future.
- *Specific gender-related issues*, in relation to sustainable work, need to be taken into account, as in any other OSH area. Such issues include reducing the high demands of certain jobs in which women predominate, for example health care and cleaning; workplace measures to support women going through the menopause; the double workload of family carers; and equal access to rehabilitation services.
- A sector- or job-specific approach allows interventions to address the specific work challenges identified and takes account of the specific context. Many of the measures identified to reduce workloads in specific sectors would benefit all workers in the sector.

4.2.1 Introduction

This section explores OSH measures that can be considered to promote work ability and help to ensure that work is sustainable. It considers only those actions that can be taken within a workplace context. Clearly there are actions such as the promotion of healthy lifestyles (e.g. smoking cessation) that extend beyond the workplace. These, together with social policy changes, etc., are not covered by this review.

Some measures have already been covered in brief in section 3 in relation to specific age-related changes and in relation to sustainable work throughout working life. This section will cover OSH measures and interventions in more detail and the role of OSH systems. It covers general issues and measures in relation to some specific sectors and groups of workers. Some of the measures are broader than OSH, for example training, but are included because they are an important aspect of active ageing and they can impinge on OSH factors, such as stress.

4.2.2 Workplace interventions and health promotion

- **Age management**

A definition of age management is given by Walker (1997, cited by TAEN, 2007) as '[the] various dimensions by which human resources are managed within organisations with an explicit focus on ageing and, also, more generally, to the overall management of the workforce ageing via public policy or collective bargaining.'

With a growing awareness since the 1990s of the implications of an ageing population, public policy initiatives have sought to reverse policy on early exit from the labour market and reduce or restrict access to early retirement schemes (Walker, 2005). The emergence of age management in Europe is a response to this trend and aims to promote active ageing and age diversity in employment and to sustain productivity. Concerned with interventions at the organisational level, age management focuses on both individual and organisational factors, and has only limited links to broader policy issues.

OSH is one element in an integrated age management approach. Good practice for workplace age management interventions has been defined as encompassing the following eight dimensions (Naegele & Walker, 2006; TAEN, 2007):

- job recruitment;
- learning, training and lifelong learning;
- career development;
- flexible working time practices;
- health protection and promotion, and workplace design;

- redeployment;
- employment exit and the transition to retirement;
- comprehensive approaches covering the working life course.

Three more, overlapping, dimensions may be added to the list: changing attitudes, ergonomics and job design, and wage policy (TAEN, 2007).

As can be seen from this list, health protection and promotion and workplace design are seen as components of age management. However, other factors more traditionally considered to be related to HR management are also considered, such as working time, learning and training, redeployment and, eventually, transition to retirement. Traditional models of OSH in industry have tended to separate OSH issues (in particular safety) from HR issues. The inclusion of both OSH and HR factors in this approach can create a valuable understanding of the drivers within organisations of retaining older employees. As part of this approach, the lifelong learning concept is an important component of age management and needs to be considered, both within and outside work. Maintaining and improving work skills is essential in relation to the employability of all workers and specifically older workers. This requires that training and education opportunities are made available to older workers.

Various tools have been developed to assist with organisational interventions to manage age. One type of tool is a company age profile tool or age structure analysis tool. An age structure analysis shows the actual age structure of the workforce and its expected development in the future. This can be combined with a checklist to identify the need for action regarding the age structure, focusing on the working and employment conditions in the company. An examination is made of whether current employment and HR policy is adequate for a rising proportion of older workers, and the risks this policy entails for an ageing workforce (Morschhäuser & Sochert, 2006). This type of tool can be used together with the WAI. As mentioned, the WAI is a tool that has arisen from the work ability model to help assess individual work ability in relation to the demands of a specific job. Examples of the WAI and company age analysis tools are given in the review 'Resources for workplaces' (EU-OSHA, 2016b), which also formed part of the larger project 'Safer and Healthier Work at Any Age'. Concrete examples of checklists are also given in Morschhäuser & Sochert (2006).

Morschhäuser & Sochert (2006) also proposed the use of worker participation methods, such as workshops, to discuss age and health. Research in this area was included in the Working Late project in the United Kingdom (Haslam *et al*., 2013) in the form of the development of the Organiser for Working Late (OWL) resource. This resource was designed to engage employees in reflecting upon their work and how health and ageing have had an impact on their work ability. The resource aims to facilitate communication between workers and line managers to help in the identification of problems and solutions within the workplace.

An example of a workplace age management intervention incorporating OSH measures is given in the box below.

Age management in DSM, Netherlands

The primary objective of this process was to keep employees working and motivated until they reached retirement age. Employability was seen as a shared responsibility between employers and employees. The case study asked all business units to develop an age-awareness policy and to report back on this in six months. This was supported by the development of an instrument to help in the development of the policy centrally. Steps were taken to analyse the age profile of the workforce, determine the expected future age profile if the policy remained unchanged, set goals for the business units and evaluate the policy effects. A health promotion programme called 'Stay Fit' was also introduced, which was aimed at workers over 35. The programme took place with small groups of participants, and employees' attitudes towards work and their individual capacities were analysed; this led to the development of a plan for the future to be discussed with line managers.

An additional element of work was related to the company's fire service, for which the combined issues of shift work and an age profile greater than the rest of the company were identified. Individual work reviews and capacity reviews were conducted for employees in this role by occupational health staff, HR managers and the fire service chief.

This process led to analysis of DSM's vulnerabilities, through which it was found that there was likely to be a shortage of workers with particular skills or capacities. To cope with this, it was proposed that an age awareness policy be integrated at all stages within DSM. However, it is reported that the policies, although evidence based, were not fully implemented. This is thought to be because of a gap between policy formulation and implementation relating to the strategic position of HR and management within the business units being unwilling to implement a personnel policy that increased employment among older workers.

Source: European Observatory of Working Life, Eurofound (http://www.eurofound.europa.eu/areas/populationandsociety/cases/nl008.htm).

- **The role of risk assessments**

Although the likelihood of developing disease increases with age, this is not a reason to exclude individuals from the workforce without objective justification. With the right support, suffering from a chronic disease may not necessarily impair an individual's ability to work. With the right adjustments to reduce the demands of work, an individual's health and work performance may not be compromised. Measures should be taken for all workers to ensure that the work environment does not compromise their safety and health and promotes their well-being.

EU directives legitimise the incorporation of OSH into age management. The EU provides a legal basis for the consideration of the prevention of workplace risks at their source as a priority, taking account of any specific additional needs of vulnerable groups such as older and younger workers, pregnant or nursing mothers, migrant or temporary workers, and workers with disabilities. Adapting work to the worker is another of the prevention principles enshrined in the legislation, and risk assessment is the tool to be used for this. Age should be considered as just one aspect of workplace diversity within the risk assessment framework (EU-OSHA, 2009a) and it is essential that the full diversity of the working population is represented within the risk assessment process.

The risk assessment process is a versatile approach that can be used to help identify generic prevention measures, which would protect the physical and mental health of all workers along the life course, as well as measures to protect specific groups or individuals. As mentioned, it could also be used to identify measures to support individuals with chronic illness in the workplace (Eurofound, 2014). The work ability concept fits together with the risk assessment approach, and tools such as the WAI can be used as part of risk assessment. As well as being a requirement, consulting the individuals concerned as part of the risk assessment process is important for identifying appropriate measures.

When we consider diversity and ageing in the risk assessment process, the following issues should be considered, which have been adapted from EU-OSHA (2009a):

- taking diversity issues, including age, seriously and having a being committed to tackling these issues;
- valuing the ageing workforce as an asset (and not as a problem);
- avoiding making prior assumptions about what the hazards are and who is at risk;
- considering the entire workforce, including cleaners, receptionists, maintenance workers, etc.;
- taking measures that will make work easier and safer for the entire workforce and making these a priority, with individual attention given to older workers if necessary;
- matching work to workers (adapting the work to the individual);
- taking account of the possible effect of broader aspects of work, such as prolonged exposure to hazardous working conditions because of a lack of career progression;
- including the needs of the ageing workforce at the design and planning stage;

- linking OSH into any workplace equality actions, including equality plans, diversity plans and non-discrimination policies;
- linking to HR measures, such as age management, retirement planning, flexible working, lifelong learning and skills development;
- providing relevant training and information on ageing and diversity issues regarding safety and health risks to risk assessors, managers and supervisors, safety representatives, etc.;
- taking a participatory approach, involving the workers concerned and examining the real work situations (any adjustments for individuals should take account of their preferences);
- using a mixture of preventive measures (adapting the work to the individual, adapting to technical progress, giving appropriate instructions/training to workers, work organisational measures, such as flexible working, providing specific training, etc.), as the adoption of these interconnected measures is a key success factor;
- when making changes to the physical environment of the workplace, or buying new equipment, ensuring that those changes or purchases take account of the diversity of the workforce;
- seeking advice where necessary; this may be provided by OSH services and authorities, health professionals, safety professionals and ergonomists, disability experts, non-governmental organisations related to specific chronic diseases, etc.;
- involving the whole range of actors directly concerned, namely workers and workers' representatives, work councils, management, OSH experts, contractors or sub-contractors, public institutions, etc.

Another simple example of the application of risk assessment to age diversity is a developers' module on EU-OSHA's Online interactive Risk Assessment (OiRA) platform[7], which was produced as part of the 'Safer and Healthier Work at any Age' project (presented in Appendix B). The aim of the OiRA process is to enable access to risk assessment tools by small and medium-sized enterprises (SMEs) and to demystify the process for these companies. This basic checklist-type module for use by developers of OiRA tools for small businesses aims to help identify the main risk factors, to ensure diversity in the risk assessment process and to provide links to further tools and solutions that can be used to reduce risks for older workers. EU-OSHA has also produced a multi-lingual e-guide on managing safety and health at work for an ageing workforce (EU-OSHA, 2015a). Other tools can be found in EU-OSHA's review of 'Resources for workplaces' (EU-OSHA, 2016b).

The requirement in OSH legislation in the EU to identify and assess risks and the requirement in EU anti-discrimination legislation to make reasonable adjustments to workplaces for workers with a disability can help individuals to remain at work. For example, within the United Kingdom, the requirement to objectively justify a fixed retirement age brings with it a need to understand the risks associated with specific job requirements, and how and where those risks can be reduced. Such analyses have also helped in developing an understanding of how to implement the requirements under the anti-discrimination legislation, where reasonable adjustments have to be made to allow individuals to stay in work. Advice on using risk assessment to assist with making reasonable adjustments to workplaces is given in an EU-OSHA factsheet (EU-OSHA, 2004).

In keeping with the life-course approach to promoting sustainable work, the first priority is to take measures to improve the safety and health of all workers, based on risk assessment. Various guides and sources of good practice examples have been referred to in this report. In addition, OiRA provides practical, sector-based risk assessment tools for small businesses.

The role of occupational health services in age management

There is some evidence of the role that occupational health services can play as part of age management. McDermott *et al.* (2010), in their review of occupational health services for active age management, identified six papers specifically covering older workers, including the study by de Boer. The overall finding was that there is a need to adopt a life-course approach to the prevention of risk

([7]) OiRA webpages available at: http://www.oiraproject.eu/

factors for chronic disease and ill-health, with action starting with younger workers, while being mindful that the factors that limit work ability are likely to be of an individual nature, but can also be organisational and structural (McDermott *et al.*, 2010). de Boer (2004, cited by Crawford *et al.*, 2009) reported the results of a randomised controlled trial that involved either care as usual or interviews with specially trained occupational physicians, consultation with supervisors and the development of an individual action plan. The results show that most reasons for individuals wanting to leave work before retirement age were related to work rather than health. After assessments by the occupational physician, contact was made with HR or line managers in 72 % of cases, with changes requested to working conditions in 52 % of cases. This intervention resulted in a significant reduction in early retirement ($p = 0.04$) among the intervention group.

There has been limited research on identifying what makes a successful intervention for occupational health in relation to ageing and work (Crawford *et al.*, 2009; McDermott *et al.*, 2010). Despite this, there is a perception that there is an important role for occupational health in supporting older workers and evaluating fitness for work/work ability, but also working in coordination with other workplace actors, in particular HR managers, to adapt the workplace and working conditions to workers' abilities. To be effective in this role, occupational health staff need to be aware of and informed about OSH and ageing issues.

In the context of the ageing workforce in the healthcare sector, Weyman *et al*. (2013) put forward the case for employers' occupational health services moving away from a focus on the individual to a proactive prevention-orientated approach, 'focused on prevention of harm and promotion of wellbeing with a dual focus on (i) systems of work and (ii) individuals'. Black & Frost (2011, cited in Weyman *et al*., 2013) called for a paradigm shift to workplace occupational health, with the traditional treatment perspective supplemented by a managed approach orientated around prevention. Weyman *et al*. (2013) pointed out that this approach is in alignment with the Finnish work ability concept. Regarding the 'individual' element of the dual focus, they call for HR and occupational health practice to move away from a 'depreciation model' of employee performance to a 'conservation model'.

Given the important role that occupational health services can play, another challenge is how to ensure that workers have access to at least basic occupational health services. The role of a comprehensive, specialised occupational health service should include implementing prevention strategies for occupational risks, health surveillance, training in safe working methods, first aid and advising employers on OSH. In the optimum case, the service would be provided by a multi-disciplinary team (Rantanen, 2007). Larger employers are more likely to have an occupational health service that is either in-house or contracted from outside the organisation. In some countries, the social insurance institutions organise occupational health services, but obviously only the insured are covered.

As mentioned, the greatest challenge is to ensure that temporary workers are covered, including those employed in physically demanding work such as construction or agriculture, but also the employees of small and micro enterprises, self-employed workers and contractual workers such as cleaners or those working in the informal sector. Regarding workers and small enterprises with no coverage, Rantanen (2007) suggests that the widest coverage is possible through primary healthcare centres, although other alternatives include group services organised by several SMEs as well as coverage by the aforementioned social insurance institutions. This is in line with WHO strategy to enable primary care centres to deliver people-centred preventive, curative and rehabilitation care according to the specific health needs of working people, particularly those who do not have access to occupational health services (see, for example, WHO, 2012). This requires moving from care focused on diseases and health problems to care that puts an emphasis on optimising the functional capability of individuals (WHO, 2012). One example of the provision of occupation health services thorough primary care is an occupational health service whose advisors work in general (medical) practitioners' (GPs') surgeries and take referrals from GPs and other professionals (EU-OSHA, 2015b).

- **Ergonomics and workplace redesign**

The consideration of the design of the workplace and making changes to that workplace to enable people to work more effectively without causing them pain or discomfort (ergonomics) is not new, nor should it solely be applied to ageing workers. The application of ergonomics to the workplace is a

process that can result in better designed work for employees of all ages and can increase the sustainability of the work, helping to ensure that workers retain their health and productivity. For example, Weyman *et al*. (2013) stated that work environments and technologies that fit well with the capacities and capabilities of older workers will tend to bring benefits to the wider population, such as ease of use and a reduction in the likelihood of error or injury.

Considering ergonomics and workplace design has been suggested by a number of authors as a means of retaining older workers in the workplace. Although there are few studies that evaluate the success of this type of intervention, there is agreement that, for older workers, considering ergonomics and workplace design is one of the key components of maintaining work ability (CPWR, 2009; Moyers & Coleman, 2004).

The Australian Public Safety Commission (2003, cited by Weyman *et al*., 2013) has produced a checklist of strategies and activities to be used when considering the design of work for an ageing workforce:

The Australian Public Safety Commission: strategies and activities for use when considering the design of work for an ageing workforce

Improve work task design

- Promote the idea of employees having control over their work, depending on the organisation's needs and employee preferences.
- Reduce physical loads.
- Ensure good visibility of task-related information.
- Improve posture.
- Set reasonable work rate standards, production targets or workloads.

Improve the physical work environment

- Minimise glare.
- Ensure good lighting levels.
- Minimise noise levels.
- Eliminate hazards that may cause slips, trips and falls.
- Make allowances for working in heat.

Improve job design and work organisation

- Avoid monotony and short cycle times.
- Improve work scheduling.
- Allow flexibility in taking rest breaks.
- Allow individuals time to adapt to new tasks.
- Support flexible employment conditions.

Support and improve people's performance capacities

- Develop best practice performance standards.
- Improve training programmes.
- Develop and maintain support systems.
- Improve employee morale and expertise.

Similarly, the International Social Security Association (ISSA, 2010a) summarised the issues in relation to designing work to address the challenges associated with the prevention of risks arising from demographic change, which, if applied, would make work easier for workers and contribute to the sustainability of work:

ISSA: demographic change in the world of work — challenges for prevention

Adapt the workplace to different body sizes	Height adjustability, e.g. for worktables and chairs, possibly with footrests; work to be done in natural body positions, not in forced postures
Make tools easy to reach, visible and easy to use	Optimal space within reach; workspace dimensions suitable for the work task; easily usable tools, keyboards and displays
Make sure that information is easily readable	Large letters, clear presentation, good contrast, colour correlation, e.g. on screens and written material
Avoid lifting and carrying heavy weights	Reduce weights; where possible, do not carry heavy items alone; use lifting aids where required; use conveyor belts, etc.
Create pleasant environmental conditions at the workplace	Adequate lighting, good ventilation, comfortable climate without draughts, noise reduction
Simplify machine operating, make work safer; emphasise active and passive safety systems on vehicles	Increase safety through additional machinery fittings; fit advanced driver assistance systems

In addition to these physical ergonomic changes, other ergonomics factors should also be considered, such as work organisation, including examination of workload and intensity, a reduction of high-load activities for all workers and recognising the competencies in different groups of people, such as experience in older workers (ISSA, 2010a).

The Institute for Occupational Health and Safety of the German Social Accident Insurance (IFA) has also collated information on the ergonomics of workplace design for older workers (ISSA, 2010b):

ISSA: ergonomic work design for old and young workers — a case study of IFA

As Germany has an ageing workforce, a number of changes have been introduced, such as an increasing retirement age, financial incentives to extend working life and increased flexible working. The development of ergonomic workplace designs has been identified as an important part of the risk prevention strategy for all age groups.

The main objectives of the project were to:

- reduce physical workloads;
- increase OSH measures in comparison with non-ergonomic designs;
- increase efficiency and productivity.

The first stage of the project was an ergonomics analysis of workload and quantification of the risk factors (environmental, musculoskeletal or psychological) in the workplace. Ergonomics design processes were implemented in companies, including improving work organisation and training workers. This whole process was evaluated on completion.

One industry involved in the research was the German sewing industry, which has experienced high levels of sickness absence and musculoskeletal problems. Workplaces were redesigned to allow both standing and sitting at work, and this was found to reduce some of the risks of musculoskeletal problems.

Other sectors were the repair industry, in which an economic evaluation was undertaken, which identified the costs of the intervention as €60,000 but found that, after one year, sick leave had reduced by 16 % and productivity had increased by 15 %.

The lessons learned from this case study are as follows:

- Ergonomic work design is only one aspect in the risk prevention strategy, but it is an important one.
- Improvements in ergonomics require knowledge of the task, specific risk profiles and quantification of exposures.
- Humanitarian and economic evaluations are necessary to persuade companies of the need for ergonomic changes.

Yeomans (2011) cited studies that suggest that ergonomic improvements be used to reduce the physical demands of work, such as the use of power tools or manual handling equipment. Such measures would benefit all workers. She also suggested that the implementation of the European directive on the safety and health requirements of the manual handling of loads (in the United Kingdom) have already to some extent encouraged employers to adopt such measures.

Ergonomics interventions can be seen as having a positive impact on all workers, not just on older or younger workers. While more research is required to identify the impact that ergonomics can have in the workplace, including taking measurements after the intervention, examples of many ergonomic interventions to reduce physical workload, awkward postures or repetitive work can be found. Several of the case studies (EU-OSHA, 2016c) documented as part of the 'Safer and Healthier Work at Any Age' project include ergonomic measures. Good practice in designing workplaces and the organisation of work to fit users' capacities and needs is one of the key components in maintaining work ability and in improving the sustainability of work.

Workplace health promotion

Workplace health promotion (WHP) programmes are an important element for all workers in a complementary approach of measures to protect workers and promote OSH. Yeomans (2011) identified several studies that have emphasised the importance for older workers of checking for the early signs of illness, such as cardiovascular disease, and encouraging healthy lifestyles and physical fitness. She suggested that health or wellness programmes could be important for increasing physical capacity and worker mobility and preventing health deteriorations and, by doing so, for allowing the continued presence of workers in the workforce. Another study in her review found large reductions in employee absenteeism for those who participated in a wellness programme in the USA (Aldana *et al*., 2005, cited by Yeomans, 2011). Weyman *et al*. (2013) suggested that lifestyle–health interventions in the workplace may make a significant contribution as a component of a comprehensive package of intervention.

Crawford *et al.* (2009, 2010) identified that there was limited research available on WHP regarding older workers. Naumanen (2006, cited by Crawford *et al.*, 2009) highlighted that health promotion was viewed positively in their sample of 93 older workers. The positive workplace factors identified included:

- personal leadership (91 %);
- a good atmosphere (100 %);
- professional skills (99 %);
- being appreciated (100 %).

In addition to this, the following activities were considered positive by the vast majority of participants:

- health checks (99 %);
- counselling and education (92 %);
- nursing care (91 %);
- health condition tests (94 %);
- rehabilitation (94 %);

- psychosocial support (95 %);
- listening (95 %).

A literature review by EU-OSHA (2012) looked at the role of diversity in WHP. The literature that was reviewed indicated that the likelihood of participating in WHP decreases with age and is lower in males. It also found that the groups most likely to be recruited for WHP activities were not necessarily the groups most likely to show sustained participation in these WHP activities: male employees, employees with high educational attainment, employees in managerial positions and married employees are more likely to be recruited for WHP, while, by contrast, female employees, employees with low educational attainment, employees in non-managerial positions and unmarried employees are more likely to show sustained participation in WHP activities. In addition, the review suggests that sustained participation increases significantly with age and among females. This suggests that there is not a 'one size fits all' approach for WHP.

Crawford *et al.* (2009) made the following recommendations with regard to health promotion activities:

- Participation in health promotion activities should be encouraged for workers of all ages and should not be seen as applying only to younger workers.
- Older employees should be surveyed to find out whether age- or gender-specific groups for some kinds of interventions would be more beneficial and encourage attendance.
- In multi-component interventions, participation in all components, not just specific areas, should be maintained.
- As with other WHP opportunities, employees should be allowed time during work to attend.

Among the recommendations of the literature review by EU-OSHA (2012) were that it is important to consider the role of diversity when planning WHP programmes, taking account of how this may affect both the recruitment and the participation rates of workers, and that measures should be tailored and targeted to the individual needs of employees. To help achieve this, employees should be actively and continuously involved in the design and implementation of actions. The WHO also strongly recommend worker participation and tailored approaches when implementing actions (Burton, 2010).

The European Parliament report on new forms of physical and psychosocial risk (Houtman *et al.*, 2007) identified that it is perhaps not new forms of health promotion that are required but, rather, a different kind of health promotion that both promotes physical activity and also improves mental well-being.

The European Network for Workplace Health Promotion (ENWHP) advocates that WHP needs to be implemented using a broad and comprehensive approach, as workplace health is the result of policy and actions by stakeholders both inside and outside the workplace. Figure 10 illustrates this concept (ENWHP, 2013).

Figure 10: The approach of the ENWHP to promoting workplace health

Figure note: HRM refers to human resource management.

Taking a life course approach to WHP can be incorporated into this model, and the ENWHP advocates attention being paid to the sustainability of work and also measures for workers who are suffering from chronic diseases.

- **The benefit of flexible working arrangement for older workers**

The term 'flexible' working covers various types of working arrangements. Some authors apply it to 'flexible employment' (e.g. temporary workers) while others seem to apply the term to any circumstances other than full-time permanent employment with regular hours.

Looking at the implications of flexible working arrangements is highly relevant in the context of an ageing workforce. Research based on the fifth EWCS found that 40 % of women in the age group 55 to 59 years and 10 % of men in the same age group worked part-time (Eurofound, 2012b). It has been suggested that these figures are likely to increase as part-time work opportunities are increasingly included in age management practices (EC, 2012b). Dex & McCulloch (1995, cited by Loretto *et al*., 2005) suggest that male workers are more likely to opt to work part-time in the period before full retirement to make jobs more sustainable towards the end of careers (Eurofound, 2012b) or when they have poor health (Wareing, 1992, cited by Loretto *et al*., 2005). In the United Kingdom, an increase is predicted in the demand for part-time work as more workers approach the age at which they can receive their pension (EC 2012b). Loretto *et al*. (2005) noted that part-time working was the normal work pattern for workers over 70 years.

The United Kingdom Labour Force Survey (2004, as cited by Loretto *et al*., 2005) found that the majority of older workers stated that they prefer to work part-time, with 85 % of older men and 94 % of older women stating that the reason they work part-time is because they do not want to retire fully. Other reasons included already being financially secure or being able to spend time with family, the latter being noted by 21 % of women compared with 6 % of men. Christensen *et al*. (2009, cited by Yeomans, 2011) also found evidence that most of those aged over 60 would prefer to work part-time rather than full-time.

Harrison & Higgins (2006, cited by Yeomans, 2011) pointed out that flexible working allows older workers to adjust their working hours to suit personal circumstances and non-work commitments, which is something that becomes increasingly important as people age. Griffiths *et al*. (2009) pointed out that giving the option of flexible working hours or part-time hours to older workers with caring and domestic responsibilities and those managing their own long-term health problems would better accommodate their needs. Loretto *et al*. (2005) suggested three ways through which workplaces can increase the availability of flexible working to increase the participation of older workers, who may prefer not to or are unable to work full1-time:

- Workplaces could encourage the retention of older workers by providing reduced hours of work or adjusted roles within the workplace.
- Employers could offer 'bridge employment', in which opportunities are provided to ease the transition between a full-time working career to full-time retirement (e.g. an altered mentoring role for newer employees or a reduction in working hours).
- Employers could increase the availability of flexible working hours to older adults, which might encourage (or enable) those currently not in work to return to employment on a flexible basis.

Working part-time may be a means of extending working life for those reaching the end of their careers. However, part-time workers are often excluded from workplace safety and health initiatives, so the inclusion of these workers in training and prevention must be incorporated into future changes.

- **Utilising skills and enhanced training**

Other measures that can help to extend working life include training and adopting an approach that views older workers as an asset and seeks to use their skills and experience by developing their role, for example through training, supervising and mentoring younger, less experienced workers. It is suggested that, while, in general, worker productivity may not decline significantly under the age of 70, this is dependent on workers receiving suitable and sufficient training in order to keep their skills up to date (HSE, 2010, cited by Weyman *et al*., 2013 and Cedefop, 2012, cited by Weyman *et al*., 2013).

Often seen as an aspect of psychological or cognitive 'fitness', maintaining up-to-date skills and knowledge should be seen as an important component of active ageing. Opportunities for learning and updating skills need to be made available to all workers (Benjamin & Wilson, 2005; Crawford *et al.*, 2009). The concept of lifelong learning is often associated with this but has a broader definition in relation to accessing formal and informal learning opportunities for both employment and personal development. In its report on combating the challenges in the insurance sector raised by demographic change, Insurance Europe (2012) identified that lifelong learning (across all working ages) was key to maintaining a sustainable workforce. Older workers will also need training for mentoring or supervisory roles if this is to be used as a means of transferring them out of physically demanding work.

Training has specific implications for the older worker, not only in relation to their training needs, but also because the requirements for that training, in terms of the most appropriate training methods, can change over time.

In terms of access to training, the Employment Equality Directive (Directive 2000/78/EC) requires equal access to all types and to all levels of vocational guidance, vocational training, advanced vocational training and retraining, including practical work experience. However, Eurofound (2012a) identified that for men an increase in not receiving employer-paid training starts to be seen at the age of 40, reaching 72 % after the age of 60 for men, and for women when they enter their 50s. This lack of access to training can be a source of stress for all workers, but particularly for older workers if they are viewed as having outdated skills.

How different groups of workers learn should also be carefully considered. This includes an examination of how training is delivered, by whom and in what type of environment. Training should be tailored to specific groups, using a basic understanding of how people learn, as the most appropriate methods to use may be different for different groups of workers. Older workers may be unfamiliar with, or have been away from, formal classroom education and testing for many years. Types of adapted training for older workers could be self-paced training, with time for reflection and rehearsal (Crawford *et al.*, 2009), and active learning rather than passive learning may be more effective. Kowalski-Trakofler *et al.* (2005) suggested that, for older people, better learning experiences occur through personal experience, with more opportunities for active peer-supported learning and mentoring. Furthermore, the work of Sanders *et al*. (2015) highlighted the need for extended training periods of a minimum of five days. In addition, involving older workers in the training and mentoring of younger, less experienced workers can result in the older workers being regarded as assets rather than as burdens (EC, 2012a).

To help older workers to learn more effectively, the ENWHP suggests the following when designing training for older workers (Morschhäuser *et al.*, 2006):

Age-appropriate approaches: guidelines from the ENWHP

- Include the participants in the design of the courses and material

  Adult education sees the independence of its participants as a precondition for success — when learning, older people should be included as co-designers of educational programmes.
- Break down prejudices about older workers' ability to learn and their efficiency

  Prejudices about older workers' ability to learn and their efficiency frequently lead to motivational barriers and a lack of self-confidence, which create obstacles to learning. Prejudices such as 'You cannot teach an old dog new tricks' should be addressed up-front and dismissed by scientifically backed counter-arguments.
- Use active methods of learning and teaching

  Active learning and teaching methods should be used. Classic teacher-oriented lessons with the teacher–pupil dynamic are frequently perceived as disturbing by older adults.
- Communicate learning strategies

  Older workers unaccustomed to learning often must first 'learn to learn'. Learning strategies should be used, with learning methods expressly related to the subject matter of the qualification.
- Guarantee personal advice and support

Older workers like more personal advice and support when learning. Team-teaching works well, with the number of participants not exceeding six to eight people per teacher.

- Incorporate prior knowledge of the participants

Prior knowledge plays a crucial role in learning. Acknowledge the experience of older workers by creating analogies and using examples of what they already know, which, in turn, helps them to learn.

- Communicate connections, structure learning material and reduce complexity

Older workers respond well to clarity — seeing the overall context of what is to be learned, along with an organised break-down of the teaching material, helps to reduce the complexity of the material and promote successful learning.

Weyman *et al*. (2013) advocated the need to train line managers, in particular, in the principles of good practice for managing an older workforce, given their key role in the management of older worker issues.

4.2.3 Employees with chronic diseases, return to work and rehabilitation

- **Employees with chronic diseases**

As previously mentioned, it is erroneous to think that someone has to be completely fit to work (Black, 2008) and having a health problem is not a valid reason for excluding someone from the workplace (Crawford *et al*., 2009). According to the evidence reviewed by Yeomans (2011), declining health does not necessarily affect job performance. When functional impairments (temporary or permanent) affect work, an employer can often take simple and effective steps to identify when employees are experiencing difficulties and to adjust the work organisation, job role or work environment to remove or reduce these difficulties (Black, 2008; Yeomans, 2011). Some adjustments can benefit workers of all ages, for example the introduction of equipment to reduce the physical demands of a particular task.

Measures implemented early to help people with chronic diseases to remain in the labour market would seem to be an important aspect of increasing the employment rate of the population between 20 and 64 years and beyond as official pension ages rise. The ENWHP has carried out an initiative on promoting healthy work for people with chronic diseases. In addition to cases studies, practical guidance for workplaces (Knoche et. al., 2012) and related return-to-work approaches, it has formulated nine broader policy recommendations (Heigl, 2013):

1. Focus on the prevention of chronic diseases in the workplace.
2. Detect chronic diseases at an early stage.
3. Shift the focus from reduced performance to retaining working ability.
4. Address discrimination against persons with chronic diseases — disability discrimination legislation, which can be applied to people with health problems, can support measures in this area.
5. Raise the importance and priority of return to work on the policy agenda.
6. Ensure that work is rewarding.
7. Ensure there is systematic cooperation of all relevant players and stakeholders — including linking WHP measures and OSH measures.
8. Raise health literacy and empowerment — including health education though all life stages and phases.
9. Fill the gap in existing knowledge and extend and maintain evidence and experience-based interventions.

Eurofound (2014) found that the use of the term ‘chronic diseases’ is rare in employment-related legislation, while the concept ‘disability’ is common, and that, therefore, more could be done to develop specific policies on chronic diseases. Eurofound (2014) also pointed out that OSH risk assessment can be used to identify risk factors for chronic diseases among employees in certain sectors, occupations or enterprises.

- **Return to work and rehabilitation**

The importance of a return-to-work policy is featured in the list of recommendations made by the ENWHP in relation to workers with chronic diseases (Heigl, 2013) and, according to Eurofound (2014), there should be a focus on the retention of people with chronic diseases in work rather than financial compensation and benefits. As has been stated previously, the ageing of the workforce increases the prevalence of workers who have developed health problems. This can lead to long-term sickness absence or early retirement from the labour market. Both result in major burdens for the individual, the workplace and society. There is a need to develop effective rehabilitation procedures to retain people on medium- or long-term sickness absence at work. If appropriate measures were taken to facilitate return to work, rehabilitation and reintegration, fewer workers would have to face long-term sickness absence, work disability or early retirement.

Return to work and rehabilitation are covered by a separate review within the project (EU-OSHA, 2016d). The following key issues were identified as part of that review:

- Early intervention is key, with success linked to a greater focus on staying in work rather than reinsertion once out of employment.
- Early detection and prevention can be achieved through providing access to occupational health services, work health surveillance and WHP.
- Interdisciplinary rehabilitation programmes addressing health, personal factors and workplace factors reduce the number of days of sickness absence and help implement a stepped-care approach, i.e. where workers are differentiated according to the duration of absence and their individual needs. This necessitates cooperation between public health, social services, employment services and the workplace.
- Successful rehabilitation interventions are those providing assessment-based, tailored and coordinated support to companies and employees.
- General medical practitioners (GPs) play a key role in return-to-work processes. Return to work needs to become a recognised clinical outcome (treatment goal) for general health physicians.
- Companies should set up disability management programmes to support the return to work of employees who have developed disabilities, or who find it hard to return to work after a protracted period of absence. These programmes should be integrated in company policies for safety and health, occupational health, sickness absence management and disability management.
- During the return-to-work process, all relevant stakeholders should communicate, cooperate and set common goals. The roles of all players should be clearly defined, and responsibilities should be taken when appropriate.
- Policies, interventions and budgets should be better aligned. Joined-up budgeting across different departments involved in rehabilitation and return to work (e.g. social security, public health, OSH and employment) should be considered.
- Public health policies should focus more on chronic diseases that are not life threatening, in particular MSDs and mental health issues.
- Companies, especially SMEs, would benefit from sharing their successful return-to-work models and approaches. The dissemination of good workplace preventive practices should, therefore, be supported, promoted and advertised.

While there is some overlap in this list with the issues identified in the section on chronic diseases above, given that the areas are linked but not identical, there are also various differences and some distinct elements.

4.2.4 Sectors and groups of workers

This section explores the OSH risks in specific sectors to which older workers are exposed and, in some cases, the actions that can be taken to reduce the effects of ageing among the workforce in relation to OSH, where available. It summarises research carried out to provide a better understanding of the

impact of the effects of ageing on different workers, which could be used to guide targeted interventions, and how the sustainability of work might be improved in those sectors. In some cases, it also documents actions already taken to support older workers in the workplace. It also considers sustainable work in relation to temporary workers, women and young workers.

- **Construction**

The construction industry is characterised by physically demanding tasks, long working hours and stressful environmental conditions, such as harsh outdoor weather (Schwatka *et al.*, 2012).

Leaviss *et al*. (2008, cited by Beers & Butler, 2012) reported that construction workers aged 60 years or older had an increased risk of suffering a fatal accident at work. Falls are the most common cause of fatal injury in the construction sector (in addition to being one of the more common causes of workplace injury overall) (Schwatka *et al.*, 2012). Research by Kemmlert & Lundholm (2001, cited by Schwatka *et al.*, 2012) suggests that those aged 45 years and over are more likely to sustain a fall from a height, as well as experience slips and trips (falls on the same level). However, there are inconsistencies in the research literature. For example, Shishlov *et al*. (2011, cited by Schwatka *et al.* (2012) reported a two-fold decrease in the injury rate from falls among workers aged 55 years and over in comparison with workers aged 20 years or younger. Leaviss *et al*. (2008, cited by Beers & Butler, 2012) noted that it is well documented that construction workers are at greater risk of health disorders than workers in other industries owing to the physically demanding nature of the work.

The most frequent type of fall reported in the sector is from elevated levels. Older workers in the construction industry who experience such a fall are more likely to be hospitalised, owing to a greater severity of injury (Schwatka *et al.*, 2012). Choi (2009, cited by Beers & Butler, 2012) examined the increase in falls in older workers in the US construction industry. Findings showed that ladders are most often involved in falls, resulting from reduced balance and coordination, decreased control of postural stability and reduced strength to correct a loss of balance. Given the widespread use of ladders, it is likely that this finding from the USA would also be applicable within the EU.

Schwatka *et al.* (2012) identified fractures, contusion/abrasions and sprains/strains as the most common types of injury in the construction sector for those over the age of 40 years. As with older workers in other sectors or industries, it has been reported that older construction workers take longer periods of sick leave than younger workers (Schwatka *et al.*, 2012).

In many workers, older age is concomitant with a longer time spent in the industry. As a result, because of longer exposure times, older workers in the construction sector are more likely to suffer from occupational illnesses such as pneumoconiosis, mesothelioma, asbestosis and hearing loss (Schwatka *et al.*, 2012). In addition, the long latency periods for many such illnesses means that these conditions will not become apparent in younger workers, with symptoms developing as they age.

Within the scope of this literature search, only limited literature was identified on actions that can be taken to reduce or mitigate the risks to older workers in the construction sector. Despite the physically demanding nature of the work, Leaviss *et al*. (2008, cited by Yeomans, 2011) suggest that accommodations can be introduced to help enable older construction workers to remain in work, such as the provision of power tools and handling equipment, and involving older workers in safety, supervisory or training roles. Welch *et al*. (2008, cited by Yeomans, 2011) suggest that measures to prolong working life in the sector should include a reduction in physical work demands, specific job accommodation after injury and special attention to functional limitations. Yeomans (2011) pointed out that measures such as the provision of equipment to reduce work demands would benefit all workers in the sector. While working conditions have been improving in the construction sector (Yeomans, 2011), more still needs to be done to prevent risks to workers of all ages. Particular attention needs to be given to measures to reduce manual handling and awkward postures in the context of sustainable work. Ways of improving health surveillance and access to occupational health services are needed and the use of work ability assessments seems to be particularly relevant to this sector. One example of an approach to promote occupational health standards in the sector is the Construction Better Health (CBH) scheme,

set up in Scotland in the United Kingdom ([8]). One of its objectives is the centralisation of the collection of work-related health data.

▪ Mining

Kowalski-Trakofler *et al.* (2005) presented research on the psychological and physical issues of work in relation to the ageing worker, before applying their findings specifically to the mining industry. In 2003, the median age of mining workers was 41.8 years old, with the prediction that this would increase in the following decade. In addition to cumulative exposure to hazardous substances and demanding physical conditions, miners work in environments where unpredictable geological conditions have the potential to change the physical environment very rapidly. Although mine operators take many measures to reduce the risk of such occurrences, it is nevertheless important that miners are able to respond to changes quickly. This requires a high level of experience, mine working knowledge and quick decision-making. Miners must, therefore, be mentally alert and aware of risks at all times. Kowalski-Trakofler *et al*. (2005) also identified that musculoskeletal injuries make up nearly 40 % of all non-fatal injuries to mine workers. The prevalence and severity of such injuries was shown to increase with age.

Kowalski-Trakofler *et al*. (2005) concluded that it is important to accommodate the needs of older workers by adopting a diagnostic approach. This involves the anticipation of losses of worker ability, in parallel with creating healthy working conditions. The paper concluded that a socio-ecological approach should be used in the mining industry, which takes on board the individual, their physical environment, the organisational climate and the community.

The National Institute of Occupational Safety and Health (NIOSH) has developed a programme that involves on-the-job training and mentoring for the mining workforce (Mallett *et al*., 2005, cited by Kowalski-Trakofler *et al.*, 2005). This method uses older workers with greater knowledge and experience to train younger workers.

▪ Hospitals and health care

Hospitals and the healthcare sector at local, national and European levels are subject to staff and skills shortages, combined with an increase in service demands (EPSU, 2006). The average age of nurses employed across six EU countries is between 41 and 45 years and, for doctors, 30 % are over the age of 55 years (EC, 2012c).

The United Kingdom is one EU Member State that has investigated the issues of an ageing workforce in healthcare work. Musculoskeletal problems, including back pain, are the main cause of early retirement due to ill-health in the United Kingdom National Health Service (NHS) (49 % in England and Wales) (Weyman *et al.*, 2013), followed by psychiatric disorders, such as anxiety and depression (20 % in England and Wales) and cardiovascular problems (11 % in England and Wales) (Pattani *et al*., 2001, cited by Weyman *et al*., 2013; Brown *et al*., 2005, cited by Weyman *et al*., 2013). The authors report that the rate of workers' sickness absence in the NHS does not increase with age. This could be due to a 'healthy worker effect', suggesting that those still working for the NHS over the age of 60 are a 'survivor' population. Costa & Sartori (2007, cited by Weyman *et al*., 2013) made a similar observation, as they did not find an increase in conditions such as dermatitis and mental health problems in older workers compared with younger ones, and the rates of reported depression were lower in older workers than in younger workers.

However, research has also suggested that older nurses have a higher incidence of injury, including orthopaedic problems, and greater levels of stress, job strain and physical fatigue (Moseley *et al.*, 2008). A further health concern within this occupational group is the identified link between breast cancer and night working. Extending working life in healthcare environments could extend the exposure duration to this risk for those working shifts. Research at the current time aims to identify the specific risk factors associated with this link, so that reduction measures can be developed in the future.

([8]) http://www.cbhscheme.com/

In addition to the hazards of heavy lifting that are often part of the daily work routine for some healthcare workers, paramedics are also exposed to the specific hazard of driving at high speeds in complex traffic conditions. While there is no specific research on paramedic drivers, other studies on professional drivers have been applied (Weyman *et al*., 2013). These studies found that the driving performance of professional drivers in their 60s does not differ from those in their 50s (see next section on road transport). However, it should be borne in mind that this research relates to drivers that travel with the normal traffic flow rather than in the complex traffic situations experienced by paramedics (and some other emergency workers).

Moseley *et al.* (2008) identified a number of measures that have the potential to influence the retention of older nurses. To avoid fatigue, they suggested that older workers may benefit from rotation between lighter and heavier work tasks, as well as increased work flexibility. In addition to decreasing fatigue, these factors could also increase job satisfaction. In considering shift scheduling, it has been suggested that workplaces could offer older nurses part-time or flexible working to help them meet their work demands (Moseley *et al.*, 2008). Research with older nurses completed by Armstrong-Stassen (2005, cited by Moseley *et al.*, 2008) reported that up to 54.5 % of nursing staff would prefer a reduction in their workload pressures and demands, with 53.7 % seeking reassignment to a less physically demanding role. Supporting this idea of a reduced physical role, it has been suggested that older nurses could take on the role of a mentor or teacher to younger workers, using their experience gained in the sector (Moseley *et al.*, 2008), allowing them to stay in work while giving the benefit of their expertise to the organisation.

The implementation of ergonomic measures to reduce the physical workload of tasks, such as patient handling, or improvements to shift working or measures to reduce stress and to support staff, would benefit all healthcare workers and contribute to a sustainable work approach. Weyman *et al*. (2013) highlighted the importance of addressing ergonomics issues at both individual and broader, more fundamental, levels. Letvak *et al*. (2008, cited by Yeomans, 2011) indicated the following accommodations that could be implemented to retain all nurses, not just older ones: minimum shift levels, limits on overtime and the use of experienced nurses in education and training. The European Commission (EC, 2011) provides guidance on measures to improve safety and health in the healthcare sector.

- **Road transport**

The average age of workers in the transportation sector is rapidly increasing, and the potential impact on work ability needs to be considered (EU-OSHA, 2009b). Work tasks involved in transportation can range from dispatch riders on motorbikes or bicycles to drivers of large lorries (heavy good vehicles) or buses.

Individuals employed in the transport sector often report musculoskeletal problems from the sustained fixed postures typically associated with driving, as well as from loading and unloading tasks. There is also the potential for psychosocial risks from tight deadlines. Furthermore, there is evidence that those involved in driving tasks are more likely to be self-employed and away from their home or office base, reducing the access to support mechanisms including occupational health, safety and well-being services. NIOSH reported that, in the USA, road traffic accidents were the leading cause of occupational fatalities for older workers, with the incidence increasing from around the age of 55. In contrast, the fatal crash incidence in the general population was found to decrease with increasing age.

The results of driving research studies into the relationships between age, cognitive decline and driving ability vary. Yeomans (2011) noted that driving is a complex task that involves multiple cognitive demands. Llaneras *et al.* (1998, cited by Beers & Butler, 2012) listed the four main cognitive processes involved: the ability to see, the ability to recognise, the ability to decide and the ability to act. NIOSH (2005, cited by Beers & Butler, 2012) reported that the following factors affect an older person's ability to drive: fatigue, medication, diminished vision (including macular degeneration), slower reaction times, declines in cognitive functioning, decreases in muscle strength and the range of joint motion, and an increased incidence of arthritis. Llaneras *et al*. (1998, cited by Beers & Butler, 2012) completed a study of truck drivers' driving abilities and performance. They found that two aspects of visual performance, the useful field of view (UFOV) and depth perception, are important factors in the incidence of road

traffic accidents for older drivers. The UFOV is the area of the visual field that can be used to acquire information with a quick glance; older drivers are less able to process this information because of a decreased attentional window. Depth perception is the ability to judge distances and decreases in this ability have been shown to occur before the age of 40 years. When applied to driving, this may mean a driver is travelling too close to the car in front.

However, Beers & Butler (2012) suggest that age itself does not predict driving performance. Driving ability cannot simply be predicted based on age. This supports the idea of having direct assessments of driving performance and ability, rather than relying on an age-related criterion to ensure that individuals are not putting themselves or others at risk while driving at work. Currently, such assessments exist only in aviation, the emergency services, mining and driving sectors. NIOSH (2005, cited by Beers & Butler, 2012), which published a factsheet on preventing road traffic accidents, reported that, to protect older workers, forward-thinking safety programmes that evaluate hazards and develop solutions on a continuous basis could be implemented, along with reasonable accommodations to work tasks.

EU-OSHA published a range of good practice case studies covering topics such as ergonomic improvements, health promotion and fatigue reduction. One finding was that this older and experienced workforce, which is used to working independently, can be resistant to change. Advice on how to involve older workers in the change process during OSH interventions included ensuring that approaches are practical but not patronising; ensuring that advice and solutions are based on drivers' experiences, for example by involving drivers in risk assessment and developing solutions; using drivers as advocates, mentors, etc.; and allowing sufficient time to develop solutions and introduce change (EU-OSHA, 2011a, b).

- **Emergency service workers**

Limited research exists on the ageing of workers in the emergency services. Considerable physical and psychological demands are placed on these workers, but there is a lack of consistency in assessing fitness and health throughout working life for this group. Work by Sluiter (2006) and Sluiter & Frings-Dresen (2007)', suggests that, while specific demands are likely to be beyond the capacity of some older workers, inter-individual differences in ability levels prevent any sort of generalisation.

Sluiter & Frings-Dresen (2007) examined the relationship between age and work ability in firefighters. They identified firefighters as being a healthy group compared with the general population. With increasing age, however, work-related ill-health increased. In addition, older firefighters were found to experience more intense emotional and psychosocial demands than younger firefighters. Older firefighters were also found to be at a higher risk of work-related absenteeism and had a higher reporting frequency in terms of health complaints. The report adds that the measures of work ability found larger variations between individuals within a specific age group than between different age groups. As a result, they cautioned against treating older workers as a homogeneous group. Understanding the broad variation in ability within a particular age group is thus an essential factor in maintaining health and work ability in this particular occupation.

Adopting an approach based on work capacity, rather than age, in decisions regarding retirement would require accurate and consistent methods for making an objective assessment of capacity and fitness for work. It is important to be able to objectively assess the health and capacity of older workers against job demands. This would allow for the consistent identification of individuals unable to continue within an emergency service role. A further complication is that it appears that older firefighters are more diverse in their capabilities than those in younger groups, making it hard to develop a coherent and fair retirement strategy for such workers.

Measures to tackle stress and to support staff, ergonomic improvements and equipment to reduce physical demands, and health promotion and rehabilitation measures would benefit all workers in this demanding work and contribute to its sustainability.

- **Automotive industry**

The automotive industry in the EU has long been a source of employment for skilled workers in many of the Member States. As with other skilled industries, the workforce in this particular sector is ageing and there is concern that the loss of older workers will result in a reduction in the skill level within the industry. The ageing of the workforce may also have an impact on productivity, due to the demands of the work versus the capacity of the workforce.

Workplace design changes at BMW were some of the most well-known interventions carried out in relation to older workers. The work itself was reported by Loch *et al.* (2010) and a summary of the intervention and findings is presented here.

The company realised that productivity was going to be affected by the increasing age of experienced workers. It was predicted that the average age of the workforce would increase from 39 to 47 years by 2017. The company understood that it could neither force older workers to retire, nor give them lighter duties, as such roles did not exist in the company. To collect more data, it decided to launch a project on one specific production line, staffed with employees with an average age of 47. The project was launched in 2007, at the same time as a company health initiative covering nutrition, smoking cessation and physical activity. The company agreed on an evaluation framework with the Workers Council (workers' representatives), covering health management, skills development, improvements to the work environment and improved retirement policies.

Both the impacts of the work on older workers and the impacts of age on productivity were evaluated. Productivity was found to reduce, on average, with age, but a significant number of individual differences were noted between workers, suggesting that productivity declines are not inevitable. The physical strain of particular jobs was measured, which led to an improved job rotation system. The most physically demanding jobs could be performed for only three hours per day by each person. Less demanding jobs could be performed for six hours per shift.

Workers on the line were asked to complete a WAI questionnaire (see section 3.2) and discuss any sources of aches and pains. Using brainstorming techniques, workers were asked to come up with solutions and to rank them by importance. The workers were provided with the support of an ergonomist, a safety officer and a process engineer, but came up with the solutions themselves.

Following the intervention, 70 changes were made to the production line including wooden flooring, barbershop chairs, orthopaedic footwear, angled monitors, height-adjusted workstations and manual hoisting cranes, for a total cost of €20,000. In addition, a physiotherapist developed stretching and strength exercises to be performed each day by the workers. Measurements showed that productivity increased by 7 % as a result of these changes, to equal that of younger workers. No results on the health or well-being of staff are yet available. The kind of economic changes introduced should benefit younger workers as well as older workers. In general, measures to make work easier and less demanding could also help with recruiting new younger workers.

- **Chemical industry**

The Age and Employment Network (TAEN) in the United Kingdom carried out a survey of age management practices in the EU chemical industries (TAEN, 2012). This survey of 276 companies aimed to identify the current state of the industry in relation to age management practices. The age management approach, described in section 4.2.2, covers a number of different dimensions related to OSH and HR.

The survey identified that nearly half (45 %) of companies in the sector either were considering demographic change or had already adopted practices to help in managing workplace ageing. Overall, 57 % of organisations had held discussions with a works council (workers' representatives) and 37 % had held discussions with the social partners under collective agreements, suggesting that the majority of these companies engaged in dialogue with employees on these issues.

The survey also asked about the type of workplace interventions taking place within the companies. Most of them covered the physical aspects of work and workplace design, with 60 % considering ergonomics issues and 55 % considering the thermal and dust environment. Other workplace issues

considered included noise (52 %), heavy lifting (52 %), awkward postures (61 %), lighting and the visual environment (58 %), repetitive work (60 %) and preventing prolonged standing (61 %). In 23 % of cases, these adjustments were designed for the whole workforce and, in 56 % of cases, they were developed specifically for older workers.

The study also examined occupational health care and health promotion activities and found that 83 % of employees had access to an occupational health service; 74 % of companies had health promotion activities in place; and 44 % supported employees in undertaking physical activity. However, the majority of companies that responded to the survey were either medium or large, so this does not necessarily reflect what happens in small businesses.

▪ Electricity and gas industries

EPSU (2008) has developed a toolkit to help the electricity industry in Europe to manage age diversity. Because of demographic change, the electricity sector has identified that half of its workforce will be eligible to retire over the next 5 to 10 years. In the electricity, gas and water sectors, 40 % of workers were over the age of 45 years in 2005, with just under half of these over 55 years.

The approach suggested by the industry is an integrated approach using age management techniques, including changing the perceptions of ageing, implementing measures across the working life course and promoting cooperation among generations.

The toolkit identified the main challenges for the industry including:

- managing an ageing workforce to ensure competitiveness and sustainability;
- valuing and retaining the skills and experience of older workers;
- creating age diversity in the workforce and tackling age-related barriers;
- developing a corporate culture that promotes a strategic and comprehensive approach to age management;
- ensuring that line managers are effectively trained to implement policies and promote age diversity;
- integrating age management policies and strategies into the social dialogue between unions and employers.

The toolkit includes both case studies and examples of good practice. It identifies the following factors as the main elements that will contribute to successful age management:

- taking a systematic and integrated approach to age management;
- promoting awareness among senior managers, HR managers, line managers and employees;
- ensuring that senior management visibly supports age management initiatives;
- taking a life-course approach to prevention for all workers;
- enhancing working conditions for older workers through initiatives such as flexible working, training and skills development;
- involving older workers in age management strategies;
- linking age and diversity strategies;
- developing procedures through social dialogue and cooperation between unions and employers;
- communicating across the company on all aspects of age management;
- monitoring and evaluating the impact of age management interventions.

The toolkit is comprehensive and covers the many different aspects of age management in the workplace. However, at the current time, there has been no evaluation of its impact within the electricity industry.

▪ Cleaners

Cleaners as an occupational group are spread across many different industries and are often on temporary or part-time contracts. The workforce is mainly made up of women and most are older

workers (Yeomans, 2011). Cleaners are exposed to a wide range of hazards (EU-OSHA, 2009c). The following hazards in particular could have implications for the sustainability of the work:

- hazardous substances;
- slips, trips and falls, particularly when carrying out 'wet work';
- MSDs from repetitive work, manual handling or the equipment used;
- standing work;
- work patterns, such as working shifts or long hours.

One literature review of cleaning work found that the level of physical work, static muscle loads, awkward postures and repetitive hand and arm movements involving high force were risk factors for MSDs and that older women were more likely to experience physical discomfort while performing sustained heavy work (Kumar & Kumar, 2008, cited by Yeomans, 2011). This is probably also a population that is less likely to have access to occupational health services and occupational health surveillance.

While no specific research was found examining the impact of ageing on cleaning work, there is the potential for better risk management in understanding the impact of long-term exposure to hazards in those who have been involved in this type of work for many years. Improvements in the implementation of OSH measures in general for the whole workforce would be important for the sustainability of the work. Such measures are well documented and there exist examples of good practice (see, for example, EU-OSHA, 2008b, 2009c). In addition, Kumar & Kumar (2008, cited by Yeomans, 2011) refer to a study that suggests that physical conditioning exercises could help cleaners to experience less physical discomfort.

▪ Temporary workers

There have been significant changes in relation to business practices and work arrangements in the last three decades, including increases in outsourcing, temporary work and self-employment (Bohle *et al.*, 2010). This is likely to have consequences, including older workers being increasingly likely to be self-employed or in temporary work. These types of working arrangements are also very common in the construction sector, which, as mentioned, has particular challenges for an ageing workforce. Bohle *et al*. (2010) highlighted the issue that younger workers may be more at risk of an injury because of reduced levels of experience in the workplace. One concern is that older workers with shorter tenure may not have that protective experience, as they are new into the workplace or are taking temporary jobs. Evidence from one study shows that injury risk associated with short job tenure was as high for older as for younger workers and thus there appeared to be a reduced protective effect for older workers. The implication of this is that job-specific experience is more important for safety outcomes than work experience per se.

An additional risk identified by Bohle *et al*. (2010) is the fact that tracking workers that are exposed to hazardous substances, for example for health surveillance purposes, will be more difficult for transient workers or workers with multiple jobs in 'portfolio employment'. Furthermore, there may be risks of reduced reporting of injuries by those who are self-employed or in temporary employment for fear of the consequences. The issue is especially problematic where there is no access to occupational health services or work insurance services external to the employer. As mentioned in the section on construction above, an example of a scheme to address the issue and to help prolong working life comes from Scotland in the United Kingdom: the CBH scheme ([9]). This scheme for the management of occupational health in the construction industry is based on findings from a pilot. Its five key objectives are (1) setting industry standards for work-related health issues and for competency of occupational health provision; (2) providing advice and support; (3) centralising the collection of work-related health data to ensure the future improvement of the health of the workforce based on valid and reliable data and the provision of a 'benchmark' for industry; (4) the transmission of data to enable employers to manage work-related health risks at site level; and (5) acting as a referral route through to specialists in the field of return to work and rehabilitation.

([9]) http://www.cbhscheme.com/

- **Young workers and sustainable work**

The risks that younger workers are exposed to will be a factor in determining their health and work ability in later life, so it is relevant to consider them when taking a life-course approach to OSH. There is some evidence that younger workers are exposed to poorer working conditions than older workers and the hazards they are exposed to include noise, vibration, heat, cold and the handling of dangerous substances (EU-OSHA, 2007). EU research data, examined as part of an EU-OSHA study, suggest that physically demanding work seems to be more prevalent for young workers, including awkward positions, handling heavy loads and repetitive work. This, combined with evidence from the study that young workers may find barriers to accessing occupational health services, has implications for sustainable working life. The study found that young workers work mainly in services sectors and low-skilled occupations and on a temporary basis, which determined their high accident rates, the risks they are exposed to and their health problems.

The impact of early exposure to hazards and previous injury or ill-health on younger workers needs to be considered, as they are likely to have the longest working life because of the need to extend working life. Consideration has to be made of how injury early in life will affect workers when they reach 60 and are still trying to work. Crawford *et al*. (2009) looked at musculoskeletal symptoms in nurses and identified that nurses reported musculoskeletal problems as a result of previous employment and working in healthcare on entry to the profession. Thus prevention of injuries during training can be seen as a key component of reducing the risk of injury at this time.

To ensure healthy young workers become healthy older workers, risk prevention strategies in workplaces should be targeting training and prevention strategies towards their younger employees as well as their older employees. Initiatives to reduce risks and raise awareness among young workers need to target both male and female young workers. Young women are more likely to work in jobs that involve caring responsibilities, nurturing and service activities that are associated with people, whereas young men are more like to work in management roles or manual and technical jobs involving machinery or plant operation (EU-OSHA, 2007). Although they are in different roles, it is important to ensure that both groups are protected from work-specific risks they are exposed to and that occupational safety and health forms part of their vocational training.

There is also some indication that younger workers are less likely to have the same access to rehabilitation measures when injured and any time off they have as a result of injury is less likely to be compensated for. It is thought that this is because of the faster recuperation time of younger workers, which may also be linked to a perception that they either are less at risk in the workplace or will 'bounce back' when injured (EU-OSHA, 2007). However, in relation to sustainability in the workplace, the prevention of injury and ill-health in younger workers is essential in order to have a fit and healthy older workforce.

EU safety and health directives require employers to address the safety and health of all employees, irrespective of age. There are additional requirements for young workers under the age of 18 years. Examples of policy, programmes and practices to prevent risks to young workers are given in EU-OSHA (2009d)

- **Women workers and sustainable work**

A separate report (EU-OSHA, 2016a) and a seminar organised by EU-OSHA (2015c) examined gender issues in relation to safer and healthier work at any age. The activities identified the following key issues:

- *Sex- and gender-related differences in working conditions persist throughout the working life:* sex- and gender-related differences influence the health issues workers may face, what jobs they do, their conditions of work and the occupational risks they face throughout their working lives. Therefore, a gender-specific approach is needed for sustainable work strategies, and policy plans should be assessed for any possible gender-specific effects. (Sex differences are biologically determined while gender differences are socially determined).
- *The cumulative physical and emotional impacts of women's work should not be underestimated:* sustainable work strategies need to focus on the cumulative impact of the exposures women face throughout their working lives (a life-course approach) in particular sectors and jobs,

including in relation to repetitive and monotonous work, prolonged standing and sitting, stress and emotionally demanding work, and paced and shift work.

- *In the workplace, support is needed for risk assessments of the cumulative exposure to hazards that incorporate the complexities of age and gender:* the assessment of cumulative exposures should take into account differences related to both gender and age; for example, older men and older women or older and younger women should be considered within one occupation/sector.
- *Segregation into low-level jobs without career promotion can lead to long-term exposure to hazards:* attention needs to be paid to women's career development, to avoid them being trapped in low-level jobs resulting in long-term exposure to the same hazards.
- *The barriers to equal access to rehabilitation and vocational training need to be tackled:* women of all ages need equal access to appropriate/adapted rehabilitation programmes, and vocational retraining should be adapted/relevant to the sectors and jobs they are usually employed in. A lack of recognition of how some health problems can be related to work, and of child and other care obligations, can be barriers to access.
- *Simple non-stigmatising workplace measures can support women going through the menopause:* an understanding of and support for female workers during the menopause are needed; such support could be as simple as providing access to drinking water. More research and practical, non-stigmatising advice for the workplace in this perceived taboo area is needed.
- *WHP strategies need different approaches for male and female audiences*.
- *Flexible work measures need to be relevant to carers of older relatives and to both men and women:* the workplace approach to family carers needs to be adjusted away from the current model that focuses on women who care for children, so that it is relevant to both male and female carers of older relatives.
- *Labour inspectorates need diversity strategies, and examples of such strategies exist:* labour inspectorates need to adopt diversity strategies in order to routinely incorporate age and gender issues into their work, avoid discrimination in their practices and be able to support workplaces effectively.
- *More research on the age–gender intersection is needed:* more research is needed on the intersection between gender and age in relation to OSH and sustainable work, combined with more practical support for the workplace.
- *Older female workers should be viewed as a valuable asset and the double discrimination that older female workers may face should be addressed through awareness raising*: simple measures can often be taken in the workplace to allow women with declining health or abilities to continue working. Measures to reduce work demands will often benefit all workers.

A more detailed summary is given in Appendix C. Examples of how to mainstream gender into OSH practice are given in EU-OSHA (2014b).

5 Discussion and conclusions

The proportion of older people in the general population is increasing across the EU. Even more importantly, the ageing of the general population is mirrored by the ageing of the working population, reflecting, in parallel to demographic trends, a number of socio-economic developments, such as the push at European level to increase the employment rate of those aged 55-64 years, and the trend in many Member States to increase the official pension age beyond 65.

An older working population, an increase in the number of years worked and continuing to work at an older age have implications for OSH and sustainable work. For workers to stay in work as they age, attention must be paid to creating good-quality working conditions, with appropriate work–life balance, employment security and lifelong learning opportunities.

Creating sustainable working conditions requires a wider understanding and appreciation of the influence of any changes in work capabilities or susceptibilities with age and the cumulative impact of exposure to risks cross the working life. This review collated evidence on the current situation of the challenges of an ageing workforce for OSH. The review examined the following three questions:

- 'What changes occur in ageing individuals within the workforce, and what are the likely impacts of work along the life course on health and ability?'
- 'What are the implications of these changes and the impacts of work along the life course in relation to OSH and sustainable work?'
- 'What OSH measures can be considered to mitigate any potentially adverse safety and health effects and to promote sustainable work along the life course?'

This section of the report summarises the findings regarding these questions, discusses the findings and their implications regarding OSH in more detail, and presents some overall conclusions.

- **Changes associated with ageing, the impact of work and the implications for occupational safety and health and sustainable work**

Key findings: the changes that occur in ageing individuals within the workforce and the impact of work along the life course on health and ability

- There are a number of *changes to physiological systems with age*, including reductions in aerobic power, muscle strength, stature, dexterity and mobility. The age at which these changes start to take place and the extent of such changes vary widely across individuals.
- *Older workers can often compensate for losses* to work-related functional capacity with strategies and skills gained through experience.
- *Physical strength and endurance is also very specific to individuals*, such that some older workers may be stronger than their younger colleagues.
- While *some cognitive abilities decline with age*, such as memory and reaction time, according to laboratory-based studies, there is evidence that work performance is unlikely to be affected, as *older individuals can generally compensate for any decline* with experience, better judgement and job-specific knowledge. The *strengthening of other mental characteristics*, such as ability to reason and motivation to learn, can also help older workers to compensate for any changes and maintain their work performance.
- The *key elements of cognitive performance* important for workplace safety and health, such as intelligence, knowledge and use of language, *do not generally show any marked decrease until after the age of 70 years*.
- Statistical data show that *older workers are more likely than younger workers to suffer from chronic health problems*, such as cardiovascular disorders and MSDs. This does not necessarily affect their work performance and *many chronic diseases are controllable.*
- *Chronological age is not the most important determinant of health*, and ageing is not inevitably accompanied by illness and disease. Health is influenced by numerous other external factors, including lifestyle, exercise and nutrition.

- The *extent of exposure to hazards throughout the working life is one external factor that can influence the health of older workers*. For example, health can be affected by long-term exposure to chemical substances or physical work. There can be a long latency period before the effects of exposure are seen, as is the case with exposure to asbestos.
- *In contrast to some stereotypical views of the abilities of older workers, they are an asset to organisations*. Older workers are often more reliable than younger workers and often show a greater level of commitment. Furthermore, turnover and (short-term) absenteeism rates are often lower among older workers than younger workers, and they have a wider diversity of expertise, knowledge and skills.

Key findings: the implications of ageing and the impacts of work along the life course for OSH and sustainable work

- *Cumulative exposure over the course of working life* to a wide variety of physical and chemical agents has implications for occupational health and, therefore, the sustainability of work.
- *Physiological changes* can lead to the deterioration of physical capabilities. This does not necessarily affect work performance, but can result in a reduced tolerance to certain aspects of physical work. There is evidence that *long-term exposure to demanding work increases the impact of deterioration.*
- While most jobs do not require workers to work at full physical capacity, some older workers with physically demanding jobs may be working at (or close to) the limit of their capacity and may, therefore, be more at risk of musculoskeletal injuries or chronic fatigue than their younger counterparts. However, experience may protect against this to some extent. In other words, the *propensity for injury is related more to the difference between the demands of the work and the worker's ability to work than to age.*
- In general, the *prevalence of MSDs increases with age*, probably as part of the normal ageing process; however, declining health does not necessarily mean a decline in job-related performance. *Other factors, such as work demands, may have a greater influence on the risk* of developing work-related ill-health than age. The increased prevalence of MSDs with age is most pronounced in workers involved in physically demanding jobs, irrespective of age.
- *A worker's physical capacity or ability to work should be used to determine if they are capable of performing a specific job and the associated risk of MSDs, rather than their age.* Employers may need to provide additional support, including adjustments to the work.
- *Some age-related changes could result in increased risk under certain circumstances*, for example exposure to extreme temperatures or driving at night.
- *Rates of accidents* at work associated with more than three days of absence are lower among older workers than among younger workers. However, older workers are more at risk of a severe or fatal accident. Although less likely to have an accident, older workers take longer to recover from any injury sustained. *Occupation, not age, is the dominant factor that contributes to risk of injury*.
- Generally, the evidence suggests that *work-related stress*, anxiety and depression increase with age and then decrease after the age of 55 years. The causes of work-related stress in older workers are different from those in younger workers. For instance, older workers are more likely to experience stress because of the responsibility they have for other people's work and the workload, rather than the physical work environment.
- There is evidence that *continuing to work under good-quality working conditions is associated with better physical health and psychological well-being* than being out of work. Good social support at work can contribute to a reduced likelihood of early retirement — workers need to be managed in an age-appropriate manner.
- There is evidence that *some older workers, but not all, have difficulties with shift work* and may need additional support or the option of non-shift work. Age is associated with changes in sleep

patterns and a reduced tolerance of routine changes, such as those usually associated with shift work. There is some evidence for a link between prolonged exposure to night work and breast cancer.

- The *experience of older workers* may enable them to increase their efficiency in the workplace (by learning to adopt different ways of working).
- Many age-related changes, such as hearing or vision changes, that could affect safety at work can generally be *corrected with simple aids or work adjustments*. This also applies to circumstances in which chronic disease affects performance at work.
- *Measures that make work less demanding for older workers would often benefit all workers*. For example, measures to prevent the development of MSDs as a result of manual handling, repetitive work, and static and awkward postures would benefit workers of all ages.

Chronological age is not the most important determinant of health and performance

The determinants of health status and performance, and the age-relatedness of both, are complex. There are a number of changes that occur across the life course in relation to physiology, psychology and human processing. However, it is apparent that ageing is a very individual process. Chronological age is not the most important determinant of health, and ageing is not inevitably associated with illness and disease. Furthermore, age is not the best indicator of performance or ability. Older workers are vastly different from each other because of the interaction of both external and internal factors with the ageing process. Important external factors include lifestyle, exercise and nutrition. No stereotype of older workers is likely to be true for all, even for the majority of older workers, particularly the belief that chronological age is the most important determinant of health and that older workers take more time off work (Benjamin & Wilson, 2005).

Weyman *et al*. (2013) concluded that chronological age is unlikely to be the best predictor of work preferences or ability, and that focusing on older workers may lead to good practice that is relevant to employees of all ages being overlooked. These authors stated that older workers essentially exhibit the same set of vulnerabilities as workers of other ages, even if considered a relatively high-risk or vulnerable group.

Benjamin & Wilson (2005) and (Yeomans, 2011) summarised some of the myths and misconceptions with regard to ageing, and why they are not true, as follows:

- Chronological age determines health, and age brings illness and disease.
    - However, health is influenced by numerous factors, not just age.
- Getting old is associated with a loss of cognitive capacity.
    - However, a decline with age is not inevitable, and some cognitive functions improve with age.
- Older workers have less physical strength and endurance.
    - However, physical strength and endurance are very specific to the individual and can be maintained through physical activity.
- Older workers tend to have poorer sensory abilities, such as sight and hearing.
    - Although sensory abilities change with age, some can be compensated for, for example by wearing spectacles.
- Older adults have difficulties in adapting to change.
    - This is not true, with resistance to change more likely to be because of the value of the change or poor communication of planned changes.
- Older adults find it harder to learn new information, making their knowledge and skills outdated.
    - This is not true; tailored training can help people learn and all employees should be offered training.
- Older workers take more time off work.

  - However, older workers have fewer short-term absences, and chronic diseases can be prevented.
- Older workers have more accidents in the workplace.
  - However, younger workers are actually more at a risk of an accident, although older workers may have more serious injuries and are more at risk of a fatal accident.
- Older workers are less productive.
  - Studies are not conclusive.

As mentioned above, one external factor that can influence the health and physical capacity of older workers is the extent of exposure to hazards throughout their working life. For example, health can be affected by long-term exposure to chemical substances or physical work, and there can be a long latency period before the effects of such exposure are seen, for example in the case of exposure to asbestos. Dworschak *et al*. (2006, cited by Weyman *et al*., 2013) stated that 'If workers are required to perform work under adverse conditions on a permanent basis, they will almost inevitably encounter health and performance problems as they grow older.' Work should help to maintain workers' physical and mental health, not contribute to its deterioration. However, according to the EWCS, workers aged 35-44 and 45-55 years are more likely to report that their health is at risk from work than those aged over 55 years, which has implications for the future health of these workers. Those aged 55 years or over in craft and elementary occupations are more likely to report that they do not think that they will be able to work until they are 60 years old than those in managerial or professional jobs. Therefore, to ensure that work is sustainable, it is important that work helps to maintain workers' physical and mental health and does not contribute to its deterioration (Eurofound, 2012b, 2015a).

Demands of work: work ability — an individual's resources in relation to work demands

As mentioned above, age-related changes happen to individuals at different ages and to differing degrees, and may also be compensated for at work, so may not affect work performance. It should also be recognised that age-related changes are not the only factors that affect a person's ability to work. Whether any such change affects work performance or not also depends on the nature of the work itself or, in other words, the demands of the work. The concept of 'work ability' looks at an individual's resources in relation to the demands of a particular job.

It is difficult to predict the effects that age-related changes may have on the work ability of those aged over 65 years, who will now more often continue to work because of increases in official pension ages. The effects of continuing to work longer may be both positive, in terms of keeping people active, and negative, in terms of exposure to occupational hazards.

Health problems may not or need not necessarily affect work performance

An individual's health may change with age, but age is not necessarily the best determinant of health status. In addition, having an illness does not necessarily mean that an employee's work will be affected. In certain cases, adjustments to work can enable an employee with a health problem to continue working. Evidence also suggests that, in general, good-quality work has a positive effect on physical and mental health and well-being, while not working has been associated with poor physical and mental health. The greatest barrier to working with a health problem may be employers' attitudes, rather than the health condition itself.

Work should be made easier and healthier for all, with specific measures for individuals if needed

According to the concept of 'sustainable work', workplaces should promote the health of workers of all ages and support those who have health conditions. This suggests that the first priority should be to improve risk prevention measures and make work easier for the benefit of all workers across the work-life course, especially in the case of mentally or physical demanding work, but also with regard to work that is associated with the risk of developing MSDs, such as working in awkward postures. It would appear that the workers who are most likely to have problems later in life if their ability to work declines,

because their work is particularly demanding, are also most likely to have their health compromised by their work.

Although physical capabilities may decline with age, this need not necessarily affect work performance. Many changes, such as age-related vision changes, can be corrected by either personal equipment or simple workplace adaptions. In many cases, adjustments can be made to specific tasks. However, if such adjustments are not possible, the transfer of workers to less demanding work should be considered in order to retain experienced workers. Evidence suggests that the consideration of work ability — an individual's resources in relation to the demands of the work — is the most appropriate way of determining whether or not any changes in a worker's health or capabilities puts them at an increased risk from their work.

Older workers should be viewed as an asset

Finally, older workers have been identified as a valuable asset to organisations, because they are often more reliable than younger workers and often show a greater level of commitment. Furthermore, turnover and (short-term) absenteeism rates are often lower among older workers than younger workers, and they have a wider diversity of expertise, knowledge and skills (Harrison & Higgins, 2006; cited by Okunribido & Wynn, 2010). It is important to be objective about the performance of older workers and counteract the stereotypical views of the abilities and attitudes of older workers that some employers may have.

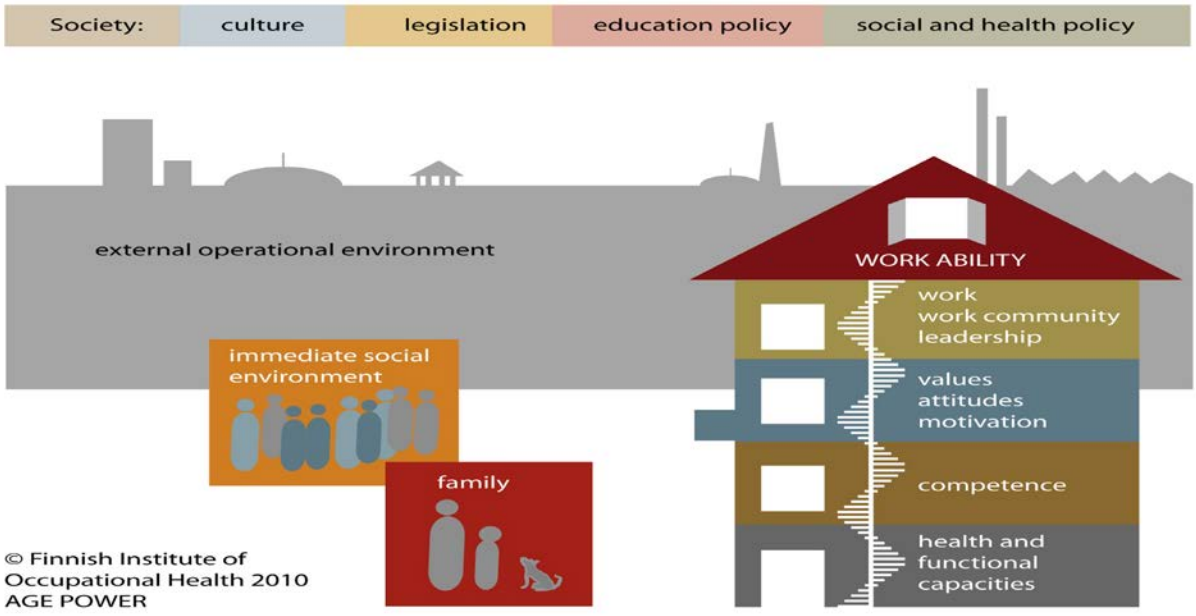
- **Occupational safety and health measures and systems that support sustainable work and mitigate any potentially adverse effects on safety and health**

Models of sustainable work

The four models of sustainable work outlined in section 4.1 present the various complex and interacting elements that can influence the sustainability of work and the work ability of individuals, and therefore the continuation in or early exit from work of those individuals. By improving understanding in this way, these models can help to inform improvements in policy and interventions aimed at retaining older workers in the workforce.

One example is the work ability model shown in Figure 11.

Figure 11: Model of work ability (FIOH)



Occupational safety and health measures and systems to support sustainable work

The models of sustainable work depict the factors from within and outside the workplace that influence work. The report examined two important influences: the safety and health of working conditions and the OSH systems, legislation and policy needed to ensure that safe and healthy working conditions are maintained, including the interaction between OSH and other policy areas, such as health, social policy, employment and education in the context of sustainable work.

Key finding: *In relation to OSH, sustainable work consists of two main elements, both of which are covered by the European legal framework on OSH:* (1) ensuring that work does not damage physical or mental health across the life course, by controlling risks to all workers (generic measures); and (2) taking additional steps if and when necessary to protect any particularly vulnerable groups or individuals.

Improved risk prevention for all workers

Therefore, the first OSH priority, in terms of sustainable work, is to ensure that working conditions do not negatively affect workers' health or their work ability, or, put another way, to ensure that work positively contributes to the maintenance of workers' physical and mental health across the work-life course. To achieve this, continued efforts are needed to improve risk prevention and make work easier and safer for the benefit of all workers. Various measures that would make work easier for all workers have been identified in this report.

There has been a downtrend in the incidence of work-related accidents in Europe. One positive influence is likely to have been the European OSH regulatory framework. For example, Yeomans (2011) states that the manual handling regulations have gone some way already in encouraging employers to introduce power tools and manual handling equipment in the United Kingdom. EU-OSHA good practice reports have identified many good practices to make work easier based on the OSH principles of the EU. However, evidence suggests that significant OSH challenges to achieving sustainable work still remain and OSH performance needs to improve if the EU is to prolong the working life of its workforce, especially in some demanding jobs.

According to the EWCS, significant proportions of the workforce report that they are exposed to challenging working conditions, such as painful and tiring positions, working at high speed or adverse social behaviour (Eurofound, 2015a). Long-term exposure to such working conditions could lead to early exit from employment.

For example, an expert forecast report by EU-OSHA (2005b) identified 10 emerging physical risks for the working population in the EU: a lack of physical activity; combined exposure to MSDs and psychosocial risk factors; the complexity of new technologies and human–machine interfaces; multi-factorial risks; insufficient protection of high-risk groups against long-standing ergonomic risks; thermal discomfort; a general increase in exposure to ultraviolet radiation; combined exposure to vibration and awkward postures; and heavy physical work.

Data from the sixth EWCS (Eurofound, 2015a) suggests that exposure to repetitive work and posture-related risks has declined slightly. However, self-reported exposure still remains significant, with 61 % and 43 %, respectively, of workers surveyed reporting that they were exposed (one-quarter of the time or more) to repetitive hand or arm movements and painful or tiring positions. Reported exposure to handling heavy loads, loud noise and vibration has also decreased to some extent since 2005. However, Eurofound suggests that these decreases may be partly due to a decline in employment in the manufacturing industry and that the actual risk level associated with such work might not have changed much.

In addition, European workers reported an increased exposure to handling chemicals and infectious materials from 2010 to 2015, as well as an increase in lifting and moving people. The sixth EWCS also provides data, given in Table 3, suggesting that self-reported exposure to some working conditions that can have an adverse impact on health is even higher in younger age groups, which presents a challenge to sustainability over the life course (Eurofound, 2015a).

Table 3: Self-reported exposure to some challenging working conditions by age (%) according to data from the sixth EWCS (Eurofound, 2015a)

	Under 35 years	35-49 years	50+ years
Painful or tiring positions (one-quarter of the time or more)	42	44	41
Working at high speed (three-quarters of the time or more)	37	34	28
Exposure to violence, verbal abuse, bullying or sexual harassment at work	18	17	13
Not able to change methods of work	34	31	27

Selected key areas in which risk prevention could be improved for all workers across the work-life course are given in Table 4, adapted from Takala *et al*. (2009).

Table 4: Selected key work-related negative outcomes and the preventable factors behind them (adapted from Takala *et al*., 2009)

Work-related negative outcome	Preventable factors
Work-related cancer	▪ Asbestos ▪ Carcinogenic substances and processes, silica and other dusts ▪ Ionising radiation; radioactive materials ▪ Ultraviolet radiation ▪ Diesel engine exhaust fumes
Work-related circulatory diseases	▪ Shift and night work; overwork ▪ Strain from high demands; low decision-making latitude ▪ High injury risk ▪ Chemicals
Accidents	▪ Lack of corporate policy and of a management system and worker–employer collaborative mechanism; poor safety culture ▪ Lack of knowledge, solutions and good practices ▪ Lack of guidance or poor government policies/legislation; poor enforcement of law; weak tripartite collaboration ▪ Lack of incentive-based compensation system ▪ Lack of or poor occupational health services ▪ Poor recording and notification systems
Infectious and parasitic diseases	▪ Poor systems of work to prevent contact and to dispose of infected waste ▪ Poor protective equipment ▪ Poor hygiene; lack of knowledge ▪ Poor protection against animals
Musculoskeletal disorders	▪ Heavy lifting, heavy loads and unusual shapes of materials ▪ Repetitive movements; forceful movements; fast-paced work; lack of rest breaks ▪ Static/awkward postures ▪ Poor design of seats, tables, tools and processes ▪ Low temperatures; vibration ▪ Stress

Work-related negative outcome	Preventable factors
Psychosocial disorders	▪ Lack of control ▪ Poor work–life balance ▪ Poor organisational culture ▪ Role ambiguity or conflict; unclear or changing priorities ▪ Lack of support for emotionally demanding work ▪ Lack of measures to prevent violence and harassment

Specific measures for older workers if and when necessary

In addition to good OSH management aimed at reducing risks for all workers, additional specific measures are needed for older workers if and when necessary, depending on the type of work and the individual, so that their work can be organised in a way that allows them to continue to work in a safe and healthy manner. This needs to be done on an objective basis, in order to avoid discrimination and to avoid actions being based on stereotypes of older workers. This implies that a diversity-sensitive risk assessment approach is needed. It is proposed that the assessment of work ability of individual workers could also be used as part of an OSH management approach based on risk assessment. Work ability assessment may be especially applicable to demanding working conditions. This report has identified various, often simple, accommodations that can be made to allow those with changed abilities or health conditions to continue working.

Key finding: *'Work ability' refers to an individual's resources (for example, physical capacity, attitudes, experience) in relation to work demands (for example, work content, work environment, work culture)*. The work ability concept has been incorporated into a self-assessment tool, the WAI, which can assist with the early identification of risks to individual workers in order to counteract them.

Occupational safety and health risk prevention measures and workplace accommodations

Various measures have been identified in this report that would make work easier for all workers, including changing the way tasks are carried out to avoid or reduce physically demanding work, exposure to repetitive work or dangerous substances, etc.; using equipment to make work easier; and improving career progression to avoid prolonged exposure to risks (in relation to, for example, highly repetitive work, which is often carried out in some female-dominated types of work).

In particular, measures to prevent the development of MSDs, caused by manual handling, repetitive work or static and awkward postures, would benefit all workers and contribute to the sustainability of work. Taking frequent breaks and the use of properly adjusted ergonomic workstations is suggested for computer-based work.

This report has also identified various, often simple, accommodations that can be made, including the use of personal devices or equipment or changes to working hours, tasks or roles, to enable individuals with reduced work ability or changes in health to remain in work.

Key finding: *OSH measures to make work easier for all and workplace accommodations to allow workers with declines in health or performance to remain in work are often very simple.*

General mitigating measures

In summary, the report has identified the following *key measures that can mitigate* adverse effects on safety and health:

- A comprehensive approach to age management in the workplace to promote sustainable work and counter the effects of ageing includes OSH, health promotion and HR measures.
- Risk assessment can support sustainable working by being used to identify risk prevention measures to improve working conditions for the whole workforce or to identify measures for specific groups or individuals. Work ability evaluation can be used as part of risk assessment.

OSH aspects of age management can be accommodated within the normal workplace risk assessment and management process.

- Health surveillance monitoring over time and access to occupational health services are issues that need to be addressed, particularly for temporary workers and small businesses.
- Ergonomics has an important role to play in reducing the demands of work for all workers and making specific adjustments for groups of workers or individuals.
- WHP interventions should be age appropriate, gender appropriate and inclusive of all age groups.
- Older workers can often benefit from appropriate flexible working arrangements, which allow them to accommodate other activities into their lives, such as responsibilities as carers, or to facilitate working with health problems. Social policy also influences whether or not workers can combine caring responsibilities and work.
- Other measures include maintaining up-to-date skills and knowledge, with training methods adapted to different age groups, and viewing older workers as an asset and developing their roles, for example through training and mentoring of younger, less experienced workers.
- The prevention of injury and ill-health in younger workers is an essential part of a sustainable work approach. The promotion of 'healthy schools' and risk education in schools is also part of a lifelong approach.
- Rehabilitation should be focused on staying in work, and early interventions are crucial. Rehabilitation programmes should be interdisciplinary. Simple workplace accommodations can often allow workers with chronic diseases to remain in work. More needs to be done to support individuals living with chronic MSDs who are either in work or planning to return to work in the future.
- Specific gender-related issues, in relation to sustainable work, need to be taken into account, as in any other OSH area. Such issues include reducing the high demands of certain jobs in which women predominate, for example health care and cleaning; workplace measures to support women going through the menopause; the double workload of family carers; and equal access to rehabilitation services.
- A sector- or job-specific approach allows interventions to address the specific work challenges identified and takes account of the specific context. Many of the measures identified to reduce workloads in specific sectors would benefit all workers in the sector.

Figure 12 was produced by the BAuA in Germany to depict various measures in the workplace that contribute to work ability and sustainable work.

Figure 12: How to improve work ability and promote sustainable work in the workplace (Sedlatschek, INQA project, BAuA, unpublished)

Support of OSH systems to promote sustainable work

Key finding: As suggested by the models*, an effective OSH system is needed to support the approach to sustainable work* of combining improved protection for all workers with measures for individuals that are at a greater risk as and when necessary.

Examples have been given to show that often very simple measures can be taken to allow older workers to continue in employment, some of which would also make work easier for all workers. However, EU-OSHA's European Survey of Enterprises on New and Emerging Risks (ESENER) and related studies show that small businesses face greater challenges in handling OSH. They have more limited knowledge and resources and there is considerable evidence pointing towards a greater risk of serious injuries and fatalities in micro and small enterprises than in larger organisations (EU-OSHA, 2016e). They, in particular, can benefit from the support of an effective OSH system. Takala *et al*. (2009) define the elements of an effective OSH system and the tools it requires: legal measures; enforcement; services available to enterprises and organisations such as occupational health services; incentives; awareness raising and campaigns; knowledge and solutions; networking for exchange of good practice; and cooperation between employers and workers, such as through tripartite advisory committees. All these areas are relevant to achieving sustainable work.

As mentioned above, the European OSH legal framework is based on risk assessment and combines collective measures to protect all workers, as the priority, with work adapted to individual workers and measures to protect vulnerable groups. This framework is supportive of achieving sustainable work if it is effectively implemented. The promotion of well-being in addition to risk prevention requirements is likely to increase the impact of legislation with regard to supporting sustainable work. The modern labour inspectorate combines enforcement activities with the provision of support, advice and information to workplaces. To carry out these roles, a labour inspectorate needs to be equipped with the appropriate tools and expertise to apply its activities to a diverse workforce.

The importance of access to occupational health services, including health surveillance throughout the working life, has been highlighted as an issue in this report. This is a problem particularly for small businesses and temporary workers, such as construction workers or cleaners, many of whom may be migrants and perform the most demanding work. The provision of basic occupational health services linked to primary health care has been suggested as one way to greatly increase the coverage of small businesses and workers not covered by employers' occupational health systems or work insurance systems. Small businesses in particular need access to OSH support in general, for example for risk assessment, and especially with regard to assessments of individual workers and for determining risk prevention measures and suitable workplace adjustments for individuals. A sector-based approach may be most effective for small businesses, as this would mean their specific needs could be more easily targeted.

Work-focused rehabilitation services are also highlighted in this report as being of key importance for workers and also small businesses. This implies the need for an integrated approach between health and social policy and employment and OSH policy, as covered by the models.

Awareness-raising campaigns should be implemented to disseminate the benefits that older workers bring to a workplace and to raise awareness of those elements of the workplace that are not suited to their needs (Okunribido & Wynn, 2010). However, this is likely to have a greater impact if combined with support and incentives for SMEs to improve OSH and to take measures to accommodate older workers or carry out WHP activities.

Continued research into OSH in general, and in relation to the ageing workforce in particular, is needed to improve knowledge and solutions. Existing OSH knowledge and best practice needs to be shared, including best practice on how to support small businesses in the context of an ageing workforce.

OSH authorities and organisations need to take a strategic approach to achieving sustainable work. The most effective way to do this is likely to be by incorporating or mainstreaming age and other areas of diversity throughout their strategy and practices. The diversity strategy of the Austrian Labour Inspectorate is a good example of how this can be done.

OSH systems can also promote a life-course approach that starts before working age, through cooperation with education policy, to embed risk education in school curricula and promote health in

schools, including through raising awareness of the ergonomics of furniture and other elements that could contribute to the development of MSDs.

Integrated policy approach

Key finding: As depicted in the conceptual models relating to sustainable work, *improving the retention of older workers is not just a function of maintaining their health and capacity and providing quality working conditions, but it is also essential to take other inter-related factors into account*, including motivation, learning opportunities and broader socio-political and institutional factors, such as income distribution, and pension and tax regimes.

As mentioned above with regard to rehabilitation, the models for sustainable work depict how various policy areas outside the workplace interact in the context of the sustainability of work, emphasising the importance of an integrated policy and services approach that includes OSH. Synergy is needed between the policies and services of OSH, employment, education, public health and social provision.

There are many social and economic factors which interact to strongly influence health and wellbeing (Marmot, 2013) and there is recognition that public health needs to take a broader approach. Marmot (2013) concludes that the public health sector needs to incorporate tackling health inequalities into the mainstream of its own core activities, but that there must also be wider engagement with other sectors. Tackling health inequalities should include tackling work-related health inequalities across the life course.

Given the evidence of persisting risks, especially in some sectors, considerable improvements to OSH are needed in many instances to prolong working lives. In cases in which work demands exceed an individual's work ability, because of the working conditions or declines in the worker's health, even after accommodations have been made, there will need to be provisions for them to either change to another field of work entirely or exit from the workforce. Therefore, complementary policies and services are especially important to support workers who, unavoidably, have to exit employment early. This, again, underlines the importance of an integrated policy approach.

▪ Gaps in the knowledge

From the evidence reviewed, the report outlines the OSH approach needed to help achieve sustainable work and the types of OSH measures that are appropriate to take in support of this. A number of research gaps have also been highlighted in the review process, identifying a need for more research on:

- how to make work sustainable for all ages and how to promote work ability in older workers in relation to changes in health and functional ability and the demands of work, and how this can be implemented within organisations;
- prevention measures;
- high-quality workplace interventions to improve the evidence base, in particular longitudinal research and also research into the types of interventions most appropriate for small businesses;
- cross-sectional methodologies to be able to follow-up people using a life-course approach to identify what factors influence staying at work, that is, longitudinal research;
- workers over the age of 65 years, developing a further understanding of the impact of extended exposure duration owing to extended working life, including physical, biological, chemical and psychosocial hazards, such as those arising from poor ergonomics design and prolonged sitting and standing;
- occupationally relevant objective measurements to identify variations in physical and mental work capabilities with age, especially for highly demanding work;
- the most appropriate health promotion strategies for different age groups and genders, to understand the requirements of different groups and whether different strategies are necessary as a result;
- risks associated with older age and the effectiveness of prevention and mitigation measures in certain sectors, for example health and emergency services, roofing and building trades.

More specific research gaps have also been identified, with more research needed on:

- the healthy worker effect, for example in relation to shift work or demanding work or in relation to the reduction in reported stress by older workers, developing a better understanding of coping strategies to meet work demands and the interplay between these two areas;
- the impact of shift work on health across the work-life course, including in relation to prolonged exposure;
- how to overcome stereotyped views of the abilities of older workers and promote them as an asset to organisations.

Overall conclusions and possible policy implications

Economic measures, such as increasing the official pension age, will be successful only if workers remain able to work and retain their physical and mental health into retirement. Work should allow the maintenance of physical and mental health, not contribute to its deterioration.

The overall aim of OSH in relation to sustainable work is to limit early exit from the workforce and ensure that working allows healthy workers to maintain their physical and mental health throughout their work-life course, and remain healthy into retirement.

While many changes in health and ability can be linked to age, ageing is not necessarily associated with ill-health or declining performance. There is a huge variation in health and ability among workers of the same age. In addition, older workers can often compensate for losses to work-related functional capacity with strategies and skills gained through experience. The focus of OSH in relation to age management should be on work ability in relation to work demands, not chronological age.

Cumulative exposure to demanding work across the work-life course can have a significant impact on health and functional ability, so is a particular concern with regard to sustainable work.

There is evidence that continuing to work under good-quality working conditions is associated with better physical health and psychological well-being than being out of work.

Improved OSH management to reduce risks and make work easier for all workers could have a significant impact on the sustainability of work. A life-course approach to OSH and sustainable work is needed for the health of workers to be maintained.

Specific measures for older workers should be taken if and when necessary — depending on the type of work and the individual — and should avoid discrimination and not be based on stereotypes of older workers.

Measures to make work less demanding often benefit all workers, for example measures to prevent MSDs caused by manual handling, repetitive work, and static and awkward postures.

Risk assessment tools can support sustainable working by identifying risk prevention measures to improve working conditions for the whole workforce or identifying measures for specific groups or individuals. OSH aspects of age management can be accommodated within the normal workplace risk assessment and management process. Individual work ability assessments can be used as part of risk assessment.

Often, simple workplace accommodations allow workers with health or performance decline to remain in work. In the workplace, HR and OSH departments should cooperate on age management and related measures.

Older workers often benefit from flexible working arrangements, which allow them to accommodate other activities into their lives, such as responsibilities as carers.

Effective, robust OSH systems are needed that are equipped to cover diversity and support SMEs and atypical workers. Access to basic occupational health services is an issue for small businesses, and health surveillance across the work-life course is needed for those workers not currently covered. OSH systems should promote well-being at work, as well as improved risk prevention measures, to achieve sustainable work.

If effectively implemented, the European OSH legal framework, based on risk assessment, combining collective measures to protect all workers as the priority with work adapted to the individual worker and measures to protect vulnerable groups, is supportive of achieving sustainable work.

A sector-based approach may be most effective for small businesses, as this would mean their specific needs could be more easily targeted.

Many factors influence the sustainability of work, from both within and outside the workplace. The integration of policies and services is needed, including between OSH, employment, education, and public health and social security, both to promote sustainable work, in order to minimise early exit from employment, and to make provisions for those who, unavoidably, need to change occupations or exit the labour market.

A comprehensive approach to age management incorporates the fields of OSH, health promotion and HR.

As with all areas of OSH policy, gender-related issues should be taken into account in relation to sustainable work.

Further research is needed, including in relation to demanding work and working sustainably after the age of 65 years. Sharing experiences of strategy development and the implementation of interventions should be promoted.

Older workers are valuable assets to organisations. Increased efforts are needed to counter stereotypical views and discrimination, and support organisations in prolonging the working lives of their employees.

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This appendix describes the search protocol that will be used for the review.

Appendix A: Search protocol

- **Topics to be addressed by the review**

The search material will provide the information basis for the topics required in the technical specifications document, so that the following is included:

- An overview of demographic change, changing retirement patterns and the societal and business costs of ignoring OSH.
- An overview of OSH issues and older workers, including the realities and myths about age and work, capability change and the impact of individual differences.
- Ensuring a holistic approach to OSH for everyone, taking into account diversity, access to occupational health (OH) and support for enterprises, in particular SMEs and micro-enterprises.
- An overview of OSH and younger workers and the importance of maintenance of OSH at a younger age to ensure life-long employability.
- Workplace health promotion and the older worker – what works and what does not.
- Hazards for older workers in relation to sectors and other risk factors.
- An overview of the interaction between OSH policy and older workers considering other policy areas including employment, health, research and education.
- A summary of key OSH statistics in relation to age including injury, health, work disability and, if available, return-to-work.

- **Search strategy for the review**

Population

Adults

Employed

Employee

Worker

Ageing worker

Older worker

At work

Economically active

Younger worker

Greying workforce

Active ageing models

Life course

Gender

Intervention

A broad definition of the term ‘intervention’ will be used, ranging from large-scale intervention studies to smaller scale workplace design changes, management training courses or safety and health considerations, with the following search terms used:

Measurement of impact of occupational safety initiative

Measurement of impact of occupational health initiative

Measurement of impact of health promotion initiative
Ergonomics
Health promotion
Occupational safety
Occupational health and safety
Occupational health
Occupational medicine
Occupational hygiene
Worker protection
Risk control
Risk reduction
Training for employees
Training for managers
Age management
Rehabilitation
Return to work
Work disability
Education

Outcomes

Reduction/increase in ill-health
Reduction/increase in sickness absence reporting
Reduction/increase in accidents
Reduction/increase in capability
Extended working life
Improvement/decline in retention of workers
Improvement/decline in morale
Improvement/decline in work ability
Improvement/decline in management style
Improvement/decline in mental wellbeing
Improvement/decline in employability
Reduction in premature departure from work

Publication types

Systematic reviews
Reviews
Guidance
Guidelines
Reports
Articles

Inclusion criteria

Employed

Employed but not working

Voluntary work

Published post-2000

Exclusion criteria

Economically inactive

Published pre-2000

Search databases

For academic research, the following databases will be used to identify published reviews:

Embase

Medline

PsycINFO

SciSearch

Sociological Abstracts

Social Sciences Citation Index

Social Policy & Practice

Social SciSearch

Grey literature searches will also be carried out using databases such as Scirus and OpenGrey. Further websites that will be searched include those of:

EU-OSHA

ENWHP

DG SANCO

DG EMPL (European Commission's Directorate General for Employment, Social Affairs and Inclusion)

DG SANCO (European Commission's Directorate General for Health and Consumer Protection)

ETUC/ETUI (European Trade Union Confederation/European Trade Union Institute)

BusinessEurope

UEAPME (European Association of Craft, Small and Medium-sized Enterprises)

CEEP (European Centre of Employers and Enterprises providing Public Services)

WHO

NIOSH

Mental Health Europe

European Social Network

EuroHealthNet

TAEN

Each study will be assessed on external validity and its applicability to the target population and to the settings defined in the scope. The following phrases will be used to evaluate the evidence in relation to each research question:

- likely to be applicable across a broad range of populations and settings
- likely to be applicable across a broad range of populations and settings, assuming it is appropriately adapted
- applicable only to populations or settings included in the studies — the success of broader application is uncertain
- applicable only to settings or populations included in the studies.

- **Identification of Member States' OSH websites and searches for relevant material**

This will include a request sent to EU-OSHA's focal points for relevant reports and tools available within each nation state. Experts involved in the project for each country will also be asked to supply relevant reports, documents and tools for this component of the work.

- **Screening of titles, abstracts and full texts for WP1 and WP3**

Details of relevant publications identified in the searches, including the title and abstract (where available), were stored in a RefWorks database. An initial screening of the titles and abstracts was carried out independently by two researchers using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (PRISMA, 2015). The inclusion criteria included:

- research on the employed, whether currently working or not;
- research on those in voluntary work;
- documents published in English, after 2000.

The exclusion criteria were the reverse of the inclusion criteria:

- research on the economically inactive;
- documents not published in English;
- documents published before 2000.

Initial screening of title and abstracts (without looking at full text)

By two independent reviewers

Score all abstracts

Score 1 = potentially eligible study

Score 0 = irrelevant for research question(s)

Score 2 = interesting paper for introduction or discussion but not answering research question(s)

Reason for excluding paper should not be documented

No consensus needed between reviewers

Screening of full-text articles

Ordering of all papers that received a score of 1

Development of scoring sheet with inclusion and exclusion criteria and add scoring YES/NO

All full texts scored by two independent researchers

Consensus needed between reviewers

Appendix B: Online risk assessment for sub-module 'older workers'

Risk statement	Negative risk statement	Information about the risk statement	Solution
Risk assessments consider any groups particularly at risk and individual capacity	Risk assessments may overlook groups who may be at risk	Equality legislation protects against age and disability discrimination at work. Safety and health legislation applies to all, regardless of age. It is not about making people work longer into later life, but is about allowing them more choice to do so and in ways that are safe. Age is not an equivalent of personal capacity to work, as declines in capacity with increasing age are not inevitable and any loss can often be compensated for by other skills. Regarding mental capacity, workers in their 60s are likely to be just as capable as younger workers. Where physical capability does decline with age, adjustments to work can help people to stay in work longer. As older workers bring a broad range of skills and experience, looking after their occupational health makes good business sense. The first priority for risk prevention is to make work easier for everyone, before looking at individual needs and taking specific measures for anyone still at risk. Most interventions to help people to stay in work longer require long-term solutions, so risk assessment is as important for young workers as it is for older workers to prolong working life. The early identification of risks allows small adjustments to be made to prevent disabilities that can lead to early exit from work. Links to further information: ▪ EU-OSHA — Factsheet 87 — Workforce diversity and risk assessment: ensuring everyone is covered — report summary ▪ EU-OSHA — Workforce diversity and risk assessment: ensuring everyone is covered ▪ ENWHP — Healthy work in an ageing Europe (for information about assessing company age management needs and work ability) ▪ Health and Safety Executive (HSE) — Health and safety for older Workers (web pages)	▪ Carry out risk assessments routinely for all workers, not just when they reach a certain age. Aim for early detection of risks and health problems. ▪ Improve working conditions and make tasks easier for all. Then consider whether or not changes are needed in the activities of older workers. ▪ Do not assume that certain jobs are too demanding for older workers — base decisions on capability and objective risk, not age, and make specific adjustments based on individual need. ▪ Modify tasks or allow workers to change work hours and job content. Provide training if necessary. ▪ Encourage or provide regular health checks for all workers, regardless of age. ▪ Promote health at work. Encourage workers to take an interest in their health and fitness. ▪ Make adjustments to tasks, equipment, working hours, etc., to help an employee with a temporary or on-going health issue to carry on working, in compliance with disability discrimination legislation. ▪ Consider general steps to manage an ageing workforce, e.g. phased retirement management, skills development or transfer of knowledge or experience to younger workers. o Avoid assumptions and get the best solutions by consulting and involving older workers.

Risk statement	Negative risk statement	Information about the risk statement	Solution
		▪ Trade Union Congress (TUC) — The health and safety of older workers ▪ TUC/Chartered Institute of Personnel and Development (CIPD) — Managing age	
Manual handling arrangements reduce risks for all and also consider individual capacity	Manual handling arrangements may not reduce risks for all and may not consider individual capacity	Manual handling legislation requires individual risk factors, such as physical ability, to be considered during risk assessment. Some older workers may be more at risk if their muscle strength and endurance has declined with age. The risk increases for those who have done a lot of heavy manual handling, especially working in awkward postures, throughout their working life. Previous or existing injury can also increase risk. To keep people at work for longer, it is important to limit manual handling for all workers and assess the work demands and recovery needs of older workers. On the other hand, decline in muscle strength and endurance can be improved at any life stage. Links to further information: ▪ Gas/electricity sector social partner guide ▪ EU-OSHA — MSDs return to work report ▪ EU-OSHA — Manual handling/MSD factsheets/case studies ▪ Eurofound — Case studies	Avoid the need for manual handling where possible. ▪ Reduce risks for all by using equipment or other technical measures. ▪ Reduce risks for all by using organisational measures such as revised scheduling and frequency of work tasks. ▪ Protect workers of all ages using the above measures and make additional adjustments on the basis of individual capacity where necessary. ▪ Train and educate all workers on manual handling risks. ▪ Introduce a healthy back-care programme, including information on rehabilitation and return to work. ▪ Evaluate and monitor the measures taken to prevent manual handling risks. ▪ Involve all workers in identifying hazards and solutions.
Physical work demands are reduced and adaptations for individual capacity are considered	Physical work demands may not be reduced and adaptations for individual capacity may not be considered	As workers age, they may become more at risk of injury and fatigue as a result of physical work. The extent of this depends on the person themselves, the type of work involved and the exact task undertaken. Some jobs are more ‘age-critical’ because of their high physical demands, although in many jobs technology can be used to reduce the strain. Where physical ability changes, adjustments can be made to help people stay in work longer. Those who remain physically fit are more able to cope, while physical capacity declines more rapidly in work that requires full exertion, especially for those who have been doing the work for a long time.	▪ Make tasks less demanding for all workers as the first priority. ▪ Look at the real effort involved before assuming that certain jobs are physically too demanding. Many jobs can be supported by technology to absorb the strain.

Risk statement	Negative risk statement	Information about the risk statement	Solution
		Reducing the likelihood of early retirement requires the management of physical capacity through better work design and occupational health care. Early intervention is important to allow workers to stay economically active for longer. Tools such as the Work Ability Index (WAI) can aid in this process. Links to: • ENWHP — Healthy work in an ageing Europe • Gas/electricity sector social partner guide • TUC/CIPD — Managing age • BAuA — WAI online questionnaire (short version) (self-assessment)	▪ Adapt the workplace and working environment where necessary to suit restricted movement of the joints, reduced elasticity of tendons and ligaments, and reduced physical functional capacity, for example cardiovascular ill-health. ▪ Provide better working conditions where necessary to accommodate reduction in visual and auditory performance or heat tolerance, i.e. improve the physical work environment by: o minimising glare; o ensuring good lighting levels; o increasing the contrast on signage; o minimising noise levels to facilitate hearing; o eliminating hazards that may cause slips, trips and falls; o making allowances for working in heat. ▪ Design workflows that take account of reduction in physical strength. ▪ Use work rotation to reduce task duration and/or frequency. ▪ Offer workers opportunities to move to physically less demanding work after pursuing the one activity for a long time. ▪ Implement workplace health promotion and health surveillance programmes for all ages. ▪ Compliment standard risk assessments by using the WAI to help identify risks to either individuals or groups of employees who need additional support. Note: participation must be voluntary.

Risk statement	Negative risk statement	Information about the risk statement	Solution
Risk assessments of ergonomic hazards take individual capacity into account where necessary	Risk assessments of ergonomic hazards do not always take individual capacity into account	Ergonomic hazards can include manual handling, back injuries, MSDs, standing at work and fatigue. As workers age, they may become more at risk of injury from ergonomic hazards, although the extent of this depends on the individual capacities of the worker and their joint mobility, muscle strength and rate of movement. Fatigue can be a result of work-related factors such as machine-paced work, shift work or complex and monotonous tasks. It is important to consider these in relation to individual worker's capacity at all ages. Employment equality legislation requires employers to make adjustments to help workers who become disabled to stay in work, and ergonomics can help with this. Links to further information: • ENWHP — Healthy work in an ageing Europe • EU-OSHA — Work — related musculoskeletal disorders: back to work • EU-OSHA — E-fact 44: checklist for the prevention of manual handling risks • EU-OSHA — E-fact 43: checklist for the prevention of work-related neck and upper limb disorders	▪ Reduce risks and prevent injury for workers of all ages. ▪ Address ergonomic risks through workplace and equipment modifications in the first instance. Base adjustments on individual needs, not age, for example: ▪ simplify machine operation; • use active and passive safety systems on vehicles and equipment; • adapt workplaces to suit different body sizes; • make tools easy to reach, visible and easy to use; • reduce the force necessary to operate tools and equipment. • Improve work task design for all workers: • maximise employee control over their work pattern; • set reasonable work rate standards, production targets or workloads; • avoid manual handling and other physical loads where possible; • ensure good visibility of task-related information; • arrange for lighter work to be carried out in a seated position when possible; • ensure that workers can move position or posture if seated work is not possible; • arrange workbenches/workstations at the optimum height and angle to reduce the need for workers to stoop or over-reach to carry out their tasks.

Risk statement	Negative risk statement	Information about the risk statement	Solution
			▪ Consider the rotation of work tasks, shifts and an increase in work flexibility in response to changes in individual capacity. ▪ Provide access to modified jobs to help people stay in work longer, with training where necessary.

Work organisation considers the activities and circumstances of older workers	Work organisation may not consider the activities and circumstances of older workers	Work organisation includes working hours and shift work. These can have varying impacts on workers, depending on their individual capacities and circumstances. Older workers may wish to reduce their hours leading up to retirement. They may wish to move from working shifts or nights. They may need some flexibility because they care for an elderly family member or for grandchildren. These wider work organisation issues are not always considered. Poor work organisation also contributes to stress and the longer you have been working in stressful conditions, the more likely you are to find that you can no longer cope.
		
		Links to further information:
		• ENWHP — Healthy work in an ageing Europe
			• Improve job design and work organisation for all by:
			  • avoiding monotonous tasks and short cycle times;
			  • improving work scheduling;
			  • allowing flexibility in taking rest breaks;
			  • allowing individuals the time to adapt to new tasks;
			  • supporting flexible employment conditions.
			• Support all workers that work shifts with due regard to their individual capacity and requirements.
			• Depending on individual capacity, give workers a priority transfer to day shifts, a choice of preferred shifts, shorter working hours, reduced workload and more frequent health checks.
			• Allow for the retention of older workers through reduced hours of work or adjustment of roles within the workplace.
			• Take steps to reduce stress for all workers.
			• Consider requirements under disability discrimination legislation and make adjustments to help a worker with a temporary or ongoing health issue.

Risk statement	Negative risk statement	Information about the risk statement	Solution
Steps are taken to manage an ageing workforce	Steps to manage an ageing workforce may not have been considered	Age management is part of good business and covers recruitment, learning, training, career development, flexible working and health protection. These factors should be considered for workers of all ages and in all stages of their career. By law, employers should not discriminate on the basis of age, disability or gender. Safety and health should not be used as an excuse for not continuing to employ older workers, nor should age be used as a reason for not receiving training. Older workers are not a homogeneous group and older women may have different needs from men, e.g. because they care for relatives or children. Simple measures can be provided to support them when going through the menopause, such as access to drinking water or adjustable, layered uniforms. Links to further information: • ENWHP — Healthy work in an ageing Europe • TUC — Age immaterial: older women in the workforce • TUC/CIPD — Managing age • TAEN — Guide to age management • Eurofound — A guide to good practice in age management • Demographic QuickCheck • BAuA — WAI online questionnaire (short version)	▪ Promote recognition and respect for workers of all ages. ▪ Maintain professional capacity and provide job training and opportunities to improve skills. ▪ Promote on-the-job learning and changes of activities for all workers. ▪ Allow staff to change work hours and job content or reduce hours in preparation for retirement, to help them remain in work longer. Increase the availability of flexible work to older adults through encouraging those currently not in work to return to employment on a flexible work basis. ▪ Reduce exposures to health risks, promote health and encourage or provide regular health checks for all staff, regardless of age. ▪ Manage return to work after illness and make temporary or permanent adjustments to support their return (hours, tasks, equipment, etc.). ▪ Carry out a company age profile to predict needs.

Adjustments are made for employees who develop ill-health problems or injuries	Adjustments may not be made for people who develop ill-health problems or injuries	A major reason for exiting the labour market, even before the age of 55, is incapacity, especially in manual trades and low-skilled work, although in all types of work employees may leave on incapacity grounds because they develop chronic illnesses. However, with simple changes at work, many workers can continue to work much longer, enabling their employer to retain workers' skills and experience. Under equality legislation, employers must make reasonable adjustments (changes to hours, tasks, equipment) to enable people with disabilities to keep working. Age-related health problems and disabilities often develop gradually and individuals may hide them, for fear of the repercussions. If unidentified, work strain could affect them further and	• Support workers who develop health problems and disabilities to continue working and manage return to work after illness.
			• Make temporary or permanent adjustments to:
			  • work equipment;
			  • working environments;
			  • working hours;
			  • distribution of tasks.
			• Provide access to health surveillance for work-related health risks.

Risk statement	Negative risk statement	Information about the risk statement	Solution
		the adjustments needed could be greater. Early intervention therefore makes good business sense. Links to: • EU-OSHA — Factsheet 53 — Ensuring the health and safety of workers with disabilities • TUC/CIPD — Managing age	• Promote health at work and access to health checks. Encourage workers to take an interest in their health and fitness.

Appendix C: Summary of the findings on women, ageing and occupational safety and health

The report 'Women and the ageing workforce: implications for occupational safety and health – a research review (EU-OSHA, 2016a) examined a number of issues related to gender, older female workers, OSH and sustainable work. It was informed by desk-based research that reviewed existing information on these topics. It was also informed by a workshop on the topic organised by EU-OSHA (2015c). A summary of the report follows.

Why review the gender dimension of occupational safety and health, sustainable work and older workers?

It is important to discuss how gender and age interact in relation to OSH and sustainable work, in order to inform policy, debate and future research on sustainable work. Age-related management that accounts for demographic change is crucial to the implementation of the objectives on increasing employment rates among women, in the context of the Europe 2020 Strategy. However, different measures may need to be taken to maintain and improve the OSH of older female workers. A gender-related dimension is important, for example, with regard to addressing measures to balance work and care responsibilities for older workers, and addressing the impact of physical work on women in relation to, for example, MSDs; and the impact of stress and burnout resulting from emotionally demanding work carried out by women. Despite a growing body of work on the separate domains of gender and age in the workplace, there has been limited research on the intersection of gender and age and OSH in relation to safety and health issues and sustainable workplaces. Nevertheless, relevant information is available from studies on gender by EU-OSHA and Eurofound.

Sex and gender differences in age-related changes

A number of changes in physical ability and health are associated with ageing, and these are influenced by sex (that is, biological) and gender (that is, socially constructed) differences, and can affect the ability of older women to work.

Women live longer than men, but they are also more likely to live longer with a chronic health condition or disability than men. The most obvious sex-specific age-related change is the menopause, although there has been very little research on the influence of the menopause on working women. Osteoarthritis and osteoporosis are diagnosed more frequently in women than in men, and are age related. Osteoporosis increases the risk of fractures in the workplace. Differences between men and women with regard to the prevalence of chronic conditions, such as chronic obstructive pulmonary disease, have been observed. These differences can also be explained by differences in the exposure to workplace hazards. Breast cancer is far more prevalent among women; evidence is growing for a link between long-term shift work, particularly night work, and breast cancer.

It is important to avoid stereotypes that relate to older workers, and older women in particular, and their work ability. For example, physical strength and endurance are very specific to individuals. For example, some older workers may be stronger than their younger colleagues. Likewise, the differences in physical ability between individual women can often be greater than those between men and women.

Declines in physical ability and health with age in women and men often do not affect work performance. Many chronic diseases are controllable. Older workers can also use their experience to adapt their ways of working. Simple measures can often be taken in the workplace to prevent early exit from work, such as equipment changes, changes in the way a task is performed, adjustments to working hours or a transfer to alternative work if necessary. Simple ergonomic measures to reduce workloads, for example lifting aids, have a positive impact on younger and older workers, the only difference being that, whereas they facilitate work for younger workers, they often make the work possible for older workers.

- **Gender-related differences exist across the work-life course**

According to the EWCS, gender differences exist across the work-life course and, generally, well-being is lower for women than for men. This gender gap widens after a woman has had children and remains wide for the rest of the life course. Vertical and horizontal segregation in the labour market exposes women generally, and older women specifically, to different risks from those that men are exposed to. This affects women's health throughout their working lives.

Vertical gender segregation leads to a concentration of women in jobs lower down the job hierarchy; this is the result of a lack of promotion opportunities and career mobility (EU-OSHA, 2013). Vertical segregation because of a lack of career mobility can lead to prolonged exposure to certain workplace hazards, such as repetitive work or work that requires awkward postures.

Horizontal segregation relates to the fact that men and women tend to work in different economic sectors. Older women are over-represented in the health and social work, education and other service sectors. In the context of sustainable work, it is important not to underestimate the physical and emotional demands of some women's work. Manual handling, highly repetitive and paced work, shift work, the risk of violence and harassment, and stress are issues that affect retention and the quality of the working life in many areas in which women work. As for other areas of OSH, strategies for sustainable work should address the sectors and jobs in which women predominate, such as health care, education, and cleaning and retail work, as well as male-dominated sectors, such as construction. This is also important in the context of an increased risk of developing MSDs as a result of desk-based work; this is especially relevant for relatively low-grade administrative workers, who have less control and variety in their work.

- **The menopause and workplace health promotion**

Other health issues faced by women related to, for example, the menopause, remain taboos in society and, therefore, in the workplace. Simple measures can be taken in the workplace to address such health issues; for example, access to drinking water can be provided, layered clothing can be used for uniforms, and flexible working can be arranged to facilitate doctor's appointments. However, more awareness raising and support for workplaces is needed, including advice on non-stigmatising measures, model policies and risk assessment checklists. In addition, more research on workplace implications is needed. Similarly, there is a need for more tailored approaches to addressing the promotion of men's health in the workplace, especially as different awareness-raising techniques are needed to engage men and women.

- **Gender-sensitive occupational safety and health strategies across the life course**

Workplace safety and health strategies for sustainable working, which start with younger workers, should be both age and gender sensitive. For example, a lifelong approach to sustainable work should encompass risk education and prevention for girls and boys in schools, and ensure that OSH education addresses the risks associated with female-dominated jobs and that OSH is included in vocational training in jobs predominantly carried out by women.

- **Stress and musculoskeletal disorders**

Stress and MSDs can have a major impact on the sustainability of women's work. More attention needs to be given to these two issues, including a focus on risk prevention in jobs predominantly carried out by women. For example, in the case of MSDs, more attention needs to be given to work that involves prolonged standing or prolonged sitting, both of which are prevalent in some jobs often carried out by women, such as at supermarket checkouts or office administration work.

- **Rehabilitation**

A specific gender focus also needs to be given to rehabilitation after work-related illnesses and to ensure that programmes are accessible for women with childcare responsibilities. A lack of recognition of how women's ill-health can be related to work can be a barrier to women accessing rehabilitation if such

access is dependent on having a recognised occupational health problem. As an example of good practice for rehabilitation, the French work injury insurance organisation Anact has promoted a guide for the rehabilitation of female workers after treatment for breast cancer; this was developed by associations of occupational physicians (Anact, 2008). Breast cancer is one of the most common female cancers and affects mainly older women.

▪ Incorporating age and gender dimensions into risk assessment and strategy development

For the promotion of sustainable work, it is important to integrate age and diversity into risk assessment, so that OSH strategies promote diversity through risk prevention and by tackling risks at their source. This should be underpinned by key principles based on the importance of collective measures, consultations with employees and valuing diversity as a resource. Therefore, it is important to address age equality, gender equality and OSH in one framework covering policy and practice.

The close link between gender equality and sustainable work is demonstrated by an intervention that was employed by a French printing company. Women working in 'finishing' suffered from exceptionally high rates of MSDs. Ergonomic improvements were recommended, but more had to be done to prevent exposure to repetitive tasks for long periods. An analysis of the length of time spent in different jobs by gender revealed that men were more quickly promoted from roles involving 'finishing' work than women, so one of the recommendations included promoting women's career path development and skill recognition, to prevent women from becoming trapped long term in repetitive jobs.

An example of integrated strategy development in a sector dominated by a female workforce is the strategy of the tripartite Working Longer Group (WLG) of the NHS in the United Kingdom ([10]). This group was established to address the impact of the increase of the retirement age from 65 years to 68 years on the NHS workforce, which is 77 % female, with nearly two-thirds of nurses over the age of 40 years. The recommendations cover four main areas: data; pension options and retirement decisions; working arrangements and the work environment; and good practice occupational health, safety and well-being. The audit of existing evidence found that, if older workers are in good health and their 'job fit' is right, they can work as productively as their younger counterparts. This highlighted the importance of fully implementing sector guidelines on health and well-being at work to ensure that a longer working life does not adversely affect an employee's health or ability to work effectively and safely. Specific recommendations were made with regard to developing and implementing a risk assessment framework, in order to assist organisations in addressing the cumulative impact of working for longer. For employers, this means supporting staff with health, safety and well-being issues throughout their working lives to enable them to work longer.

▪ Family carers

With an ageing working population and an increase in the retirement age, more workers are likely to have the responsibility of caring for sick relatives. Measures for the reconciliation of work and family life are increasingly recognised as being important in the context of the European 2020 Employment Strategy and as a driver for gender equality. Currently, 80 % of the time spent caring for people with disabilities and older people is provided by informal carers, and the highest proportion of this care is provided by women of 50 years or older. There is evidence that older men are more likely to be carers for, for example, a sick spouse or elderly parent, than younger men. However, current strategies aimed at carers focus on young women with childcare needs.

Preconceptions regarding who may be affected by care duties should be avoided in order to develop appropriate reconciliation policies and practices, which are essential for promoting the employment of both older women and older men. Flexible working schemes and part-time policies, as have already been implemented for young parents, should also be considered, in order to prevent older carers, and especially older female workers, from exiting the workforce. As well as employment policies that allow the reconciliation of work and care by employees, an ageing population in Europe requires additional resources for the care of older and disabled people and services to promote independent living as part of an integrated strategy.

([10]) http://www.nhsemployers.org/wlr

Mainstreaming diversity in national occupational safety and health strategies

Labour inspectorates need to be able to support the process of incorporating age and gender considerations into sustainable workplace strategies without causing discrimination. To do this systematically, diversity should be mainstreamed into the strategies and activities of labour inspectorates. One example of how to achieve this is provided by the diversity mainstreaming strategy implemented by the Austrian labour inspectorate, the outputs of which include a range of gender mainstreaming tools, and training and diversity checklists for inspectors to use in companies. Another example is the research and advice for employers on different areas of diversity carried out and provided by the Health and Safety Executive in the United Kingdom (EU-OSHA, 2014b).

A kindergarten in Denmark provides an example of an intervention in a workplace in which women predominate; a range of sustainable work adjustments were introduced to retain staff affected by repetitive movements and lifting. These adjustments specifically addressed the fact that workers had to bend frequently and that the available furniture was only apt for children and was not height-adjustable. Working time adjustments, external help with lifting, and advice on working methods and the prevention of MSDs were facilitated through trade union and worker involvement and access to a municipal health promotion programme, which included training for the kindergarten director.

Gaps in knowledge

More research is needed on the intersection between age and gender in relation to OSH and sustainable work. The following general knowledge gaps have been identified during the review:

- Further work is needed to improve the collection of data on hazards to which women are exposed, rather than making assumptions about work tasks and job roles, or correcting for sex and gender, in research studies.
- Because of horizontal segregation in certain sectors, such as cleaning and health care, women can be exposed to multiple hazards; further research is needed to examine this in relation to age and extending the working life.
- Further research is needed to understand why women report poorer mental health outcomes than men exposed to the same psychosocial risks.
- Further research is needed to strengthen our understanding of the impact of women's dual roles of paid and domestic work on their health, especially in the context of extending working lives.
- Studies need to include older women workers from different ethnic groups.

More specific research gaps have also been identified:

- Our understanding of the possible impact of the menopause on a woman's working life is still limited and this is an area for which further research is needed, in order to identify support strategies for the workplace.
- Further research is needed on the links between night work and breast cancer in women to increase our understanding of the potential causal mechanisms and to improve risk prevention strategies.
- Further research is needed on working with painful and tiring conditions.

Overall conclusions: taking account of gender issues in the occupational safety and health aspects of sustainable work

In the future, it will be important to create sustainable working patterns for older workers, with a specific focus on older female workers, through measures that address workloads, work tasks, flexible working hours, the work–life balance, support in the workplace for specific gender-related health issues and workforce development. Strong policy frameworks, investment and resources are crucial for supporting actions, at strategic and practical levels, on the complex intersection between age and gender. This requires consistent, coordinated actions in order to address age, gender and OSH actions related to risk management, the adaptation of work and the balance of work and care responsibilities across the life

course. In addition, more research is needed on the intersection between age and gender in relation to OSH and sustainable work, and more practical support for the workplace is also needed. Older female workers are a valuable asset to organisations. It is important to counter stereotyped views of their abilities and avoid the double discrimination that older women may face in the workplace. The key findings of the report are summarised below:

- *Sex - and gender-related differences in working conditions persist throughout the working life:* sex- and gender-related differences influence the health issues workers may face, what jobs they do, their conditions of work and the occupational risks they face throughout their working lives. Therefore, a gender-specific approach is needed for sustainable work strategies, and policy plans should be assessed for any possible gender-specific impacts.
- *The cumulative physical and emotional impacts of women's work should not be underestimated:* sustainable work strategies need to focus on the cumulative impact of the exposures women face throughout their working lives (a life-course approach) in particular sectors and jobs, including in relation to repetitive and monotonous work, prolonged standing and sitting, stress and emotionally demanding work, and paced and shift work.
- *In the workplace, support is needed for risk assessments of the cumulative exposure to hazards that incorporate the complexities of age and gender:* the assessment of cumulative exposures should take into account differences related to both gender and age; for example, older men and older women or older and younger women should be considered within one occupation/sector.
- *Segregation into low-level jobs without career promotion can lead to long-term exposure to hazards:* attention needs to be paid to women's career development, to avoid them being trapped in low-level jobs resulting in long-term exposure to the same hazards.
- *The barriers to equal access to rehabilitation and vocational training need to be tackled:* women of all ages need equal access to appropriate/adapted rehabilitation programmes, and vocational retraining should be adapted/relevant to the sectors and jobs they are usually employed in. A lack of recognition of how some health problems can be related to work, and of child and other care obligations, can be barriers to access.
- *Simple non-stigmatising workplace measures can support women going through the menopause:* an understanding of and support for female workers during the menopause are needed; such support could be as simple as providing access to drinking water. More research and practical, non-stigmatising advice for the workplace in this perceived taboo area is needed.
- *WHP strategies need different approaches for male and female audiences*.
- *Flexible work measures need to be relevant to carers of older relatives and to both men and women:* the workplace approach to family carers needs to be adjusted away from the current model that focuses on women who care for children, so that it is relevant to both male and female carers of older relatives.
- *Labour inspectorates need diversity strategies, and examples of such strategies exist:* labour inspectorates need to adopt diversity strategies in order to routinely incorporate age and gender issues into their work, avoid discrimination in their practices and be able to support workplaces effectively.
- *More research on the age–gender intersection is needed:* more research is needed on the intersection between gender and age in relation to OSH and sustainable work, combined with more practical support for the workplace.
- *Older female workers should be viewed as a valuable asset and the double discrimination that older female workers may face should be addressed through awareness raising*: simple measures can often be taken in the workplace to allow women with declining health or abilities to continue working. Measures to reduce work demands will often benefit all workers.

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The European Agency for Safety and Health at Work (EU-OSHA) contributes to making Europe a safer, healthier and more productive place to work. The Agency researches, develops, and distributes reliable, balanced, and impartial safety and health information and organises pan-European awareness raising campaigns. Set up by the European Union in 1994 and based in Bilbao, Spain, the Agency brings together representatives from the European Commission, Member State governments, employers' and workers' organisations, as well as leading experts in each of the EU Member States and beyond.

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