
# Needs and Trends Analysis Report

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GOLDEN workers

# Needs and Trends Analysis Report

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# Needs and Trends Analysis Report

## TABLE OF CONTENTS

## List of Tables

## List of Figures

## SUMMARY

This report provides an overview of ageing at work and information and communication technologies (ICT) with the purpose of providing a detail review of all the aspects of this phenomenon. This report is the state of the art review and the foundation for the Goldenworkers' project. Goldenworkers will provide a roadmap of ICT at work over 10, 20 and 30 years. The purpose of the project is to sensitize the research community, but also policy makers and society more broadly about the importance of applying ICT to improve work environments for an ageing population. The project looks at the future of ICT for ageing workers to support funding and policy decisions that will provide technologies addressing the challenges of an ageing population and a social system that is unsustainable as currently designed. Appreciating the importance of improving work environments for ageing at work can only be done within the context of an understanding of the multi-faced aspects of this important challenge.

Of course ICT is only one piece of the puzzle to respond to the challenges of keeping the social system that has been Europe's trade mark. We, society, will need to find ways to support an ageing population and one of the most feasible solutions is to extend working lives as people age healthier and more educated. Work environment, which includes both the environments of large organizations but also the markets that shape the work of small and medium enterprises and mature entrepreneurs, is just one piece of ageing at work. Other parts include issues ranging from incentives embedded in pension systems, cultural and social traditions around retirement, cultural biases around ageing workers, or supporting new life styles. ICT is an important part of the work environment, but just one part. Leadership styles, HR policies, legislation, management systems, or organizational cultures are all further aspects that will affect our success in making work attractive to ageing people.

The report is of interest to researchers, public servants, non-profit organizations, companies, and citizens interested in this important challenge that Europe is facing if it wants to remain competitive and maintain its unparalleled social model. The interests of the various readers will determine the sections of the report that they are of most use to them. For those interested in all the aspects, the report will give them a state of the art review. The final chapter builds on the review to propose a framework of ICT for ageing workers that will structure scenario planning and roadmapping for the Goldenworkers' project.

The report covers the following topics:

1. Demographics—ageing trends in Europe and compared to other parts of the world emphasizing health and education as main drivers of employment
2. Economics—economics of aging and the unsustainable structure of the current pension system requires changes to people's incentives to remain at work or retire
3. Labour markets—unemployment of aged people and the phenomenon of mature entrepreneurs
4. Socio-cultural trends—retirement in Europe and the importance of variables beyond pension-related incentives. Biases associated with ageing people at work
5. Policy trends—policies within the European Union aimed at keeping people at work
6. Information and Communication Technologies—review of frameworks of ICT for ageing population and identification of eight technologies that will change the work environment for ageing people
7. Work environment—keeping people at work requires having attractive work environments. What do ageing people need at work?
8. Framework for Goldenworkers.

Demographic and economic forces are converging towards keeping ageing people at work. Unless Europe is able to create more and higher quality jobs also for ageing people, these forces will lead to lower quality of life for older people. Goldenworkers—older people who choose to remain at work—will be a central constituency in the future. Fast moving knowledge and skills requires goldenworkers to adapt to changing labour demands. Conversely, work environments and markets need to be attractive to this group. In both sides of the challenge, ICT will play a crucial role as its already large influence in organizations and markets expands.

Despite the unfortunate bias against age in the workplace, goldenworkers have been shown to contribute in important ways to organizations and society. Research has found no relevant differences between aged and younger workers that would explain this bias. On the other hand,

information and communication technologies (ICT) have revolutionized work environments across most industries regardless of whether they are high tech or not. Going forward, ICT is expected to keep on transforming the way we work.

This report documents the intersection between work environments for goldenworkers and ICT. Its objective is to establish a framework for evaluating future scenarios and defining a roadmap for ICT and goldenworkers.

The analysis of various classifications of technology led to identifying the following technologies to build scenarios and roadmaps for goldenworkers:

1. Ambient intelligence
2. Augmented and virtual reality
3. Affective computing
4. Robotics
5. Internet
6. Invasive technologies
7. Quantum computing
8. Design approach

These technologies plus the approach to including user-friendliness from the very start of the design process will be examined to analyze the future of ICT for goldenworkers.

We identify six fundamental work functions in organizations and markets and evaluate the impact of current and future ICT on them. These six work functions are:

1. Learning
2. Communicating
3. Coordinating
4. Collaborating
5. Productivity
6. Knowledge management

ICT has already changed and will change the way in which work is adapted to the needs of ageing people. Their needs for gradual retirement, flexibility, lower cognitive and physical capabilities, disabilities, or health problems, lower working hours, or multiple jobs will be integrated into work environments through personalized, adaptive, and anticipatory functionality. Interestingly, the convergence of ICT and goldenworkers will provide solutions also relevant to other work groups such as parents of young siblings, who need flexibility or people with disabilities.

The report also considers three types of work environments with very different demands on the work functions identified:

1. The large organization that has complex management challenges but also has specialized resources.
2. The small and medium enterprise with simpler internal management issues but more exposed to forces of product market.
3. The mature entrepreneur who decides to become self-employed after their careers in established organizations.

The analysis in this report should be read as reflecting general trends associated with ageing at work and ICT. Large differences exist across individuals, therefore solutions should be adaptive and personalized both characteristics embedded in current and future ICT solutions. Furthermore, successful intervention initiatives should be function-based – i.e. based on an assessment of the characteristics of individual workers – rather than age-based.

## 1. INTRODUCTION

The objective of the present document is to provide a review of the state the art of **ageing at work and the role of ICT**. In particular, it adopts a multidisciplinary and comprehensive approach to the state of play in order to **evaluate current and future ICT applied to work environments for an ageing population**. The document analyzes the demographic, social, economic, policy and cultural forces shaping the European society in terms of ageing and in particular of ageing at work. Next it analyzes the state of the art of different ICT that have an impact on existing and future environments of ageing at work. Finally, the document presents a **framework to structure our thinking about the intersection of ageing at work and ICT** that will serve as a basis to future work on scenario analysis and road-mapping.

**The objective of the present document is to provide a review of the state the art of ageing at work and the role of ICT**

After a description of the methods underpinning this research, the document presents a snapshot on the **phenomenon of ageing** (Chapter 3). Section 3.1 is devoted to the **demographic** aspect of ageing (demographic components, principal ageing indicators and future projections) with a special attention to the issue of health and disabilities for older population in the European context. The 'map' of the current state of ageing and in relationship to work and retirement is summarized through statistics, data and projections. Section 3.2 provides background on **education** levels because of its relevance to employment and ageing at work. Sections 3.3 and 3.4 discuss **economic** and **labour market** challenges with an emphasis on pensions and unemployment. These sections also emphasize the phenomenon of **mature entrepreneurs**. These are ageing workers who choose to start their own business instead of joining and existing organization after their career in an organization. Statistics reveal that this is a common phenomenon for goldenworkers to remain at work. Mature entrepreneurs are also relevant because the effect of ICT at work goes beyond organizational work challenges to include the impact of ICT on markets where these mature entrepreneurs provide their services. Section 3.6 focuses on **policy trends** at the EU level.

Chapter 4 analyzes **ICT technologies** with a look at previous work done on technology and ageing. Most of these efforts have looked at ageing broadly emphasizing medical and independent living with ageing at work as a peripheral interest. Still, the concepts and frameworks developed are related to our own more specific framework. This chapter also looks at individual IC technologies that are called to play a role in supporting ageing at work. The chapter reviews various classifications of technology functions and technologies to centre around seven technologies: (1) ambient intelligence, (2) augmented and virtual reality, (3) affective computing, (4) robotics, (5) internet, (6) invasive technologies, and (7) quantum computing. The chapter also emphasizes the importance of design to facilitate adoption of ICT at work.

Chapter 5 looks at ageing at the individual level of analysis, combining insights from various literature streams so as to provide a broad overview of the principal changes—mental, physical and psychological—that occur as individuals age. Particular emphasis is put in clarifying how these changes relate to **work ability of older workers**. Insights from various literature streams, such as economics, industrial gerontology, psychology of ageing, organizational behaviour and management are summarized and organized around a conceptual framework of work ability to highlight the **complexity of the phenomenon of ageing at work**. Work ability (i.e., individual ability to work) is a process of human resources (i.e., resources and capabilities 'owned' by an individual including health, mental capacities, skills and knowledge, values, etc.) in relationship to work characteristics (such as nature of job demands, work environment, etc.). Our review reveals that the phenomena at the nexus between ageing, work and retirement is **multidimensional**, characterized by multiple ingredients and complex interdependencies that operate at different levels of analysis (such as national, organizational and individual).

Based on the analysis of individual level characteristics of ageing at work, chapter 5 identifies the various functions that need to be addressed at work where ICT will have a relevant impact. These functions include: (1) **learning and exercising**—work demands on up-to-date knowledge and skills together with the special attention that ageing people have to pay to maintaining physical and mental flexibility; (2) **communication**—work demands on communication with remote communication gaining importance through the use of ICT; (3) **coordination**—work demands associated with human logistics as flexibility takes a more central role and with bringing together supply and

demand curves in the market; (4) **collaboration** and teamwork—work demands on team work that will become more important as teams work from different locations; (5) **productivity**—work demands on increasing productivity across age groups but with especial emphasis on older workers who might suffer from diminished physical capabilities but also age discrimination; and (6) **knowledge management**—work demands on sharing and transferring knowledge not only to get a particular project done but also to insure that knowledge is not lost after retirement.

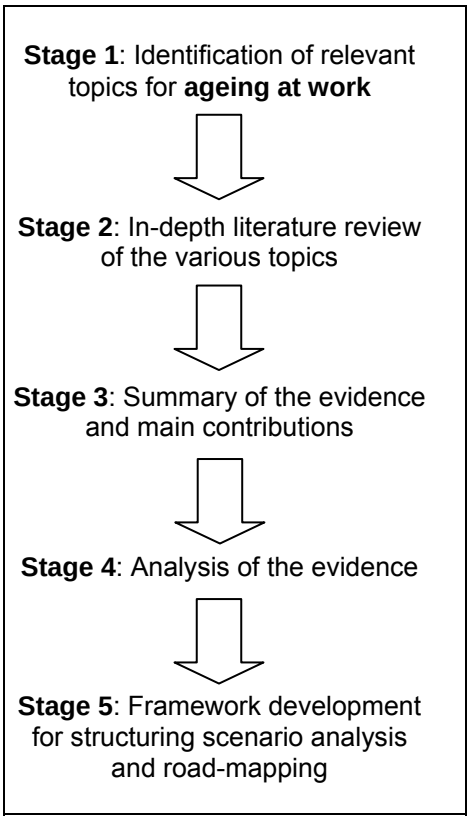
These various functions are analyzed at several levels. At one extreme, there is ageing at work within **large organizations** that will have the tools, policies, and interests to accommodate ageing people. At the other extreme, there are **mature entrepreneurs** who start offering new services and ageing at work means having access to the market. In between, we also analyze ageing at **SMEs** where the ageing worker may be the owner and because their policies may lag behind those of larger companies

Chapter 6 integrates the previous work to present a **framework combining the functions associated with work with existing ICT** that summarizes the analysis presented in the previous chapters and provides the structure for the scenario analysis and road-mapping.

## 2. METHODS

**Figure 1** outlines the method used for the elaboration of this project.

**Figure 1: Project method**




The current report is based on a research process that includes five steps.

First, an in-depth review of existing knowledge identified the different topics associated with ageing at work. This process was based on **previous reports** done at the EU level together with a careful review of existing **academic and practitioner literature** as well as **publicly available databases**. EU projects reviewed were AAliance, ePal, Senior, BRAID, ETICA and FUTURAGE. Academic and practitioners' sources included Business Source Complete, Econlit, JStor, and Factiva. Data comes from sources such as OECD and Eurostat. In addition to the specific topic of ageing, the report also gathered topics around management and the requirements associated with management functions. Through this process new topics were identified and included in the review.

The second step was an in-depth review of the existing **theory, concepts, frameworks,** and **evidence** on the topics identified. This review included EU reports, practitioners' information, and academic literature. Relevant documents were searched using databases and contacting experts who pointed out to relevant literature. Each of the topics in this report is itself a broad discipline, so the report captures the salient aspects of each topic to the issue of ageing at work and does not aim at being an in-depth review of each topic.

This broad literature review is summarized in the early chapters of this document. The summary is intended to be detailed enough for readers to gain enough depth to appreciate the importance of the topic and the relevance of the framework proposed.

**The current report is based on a research process that includes five steps**

The fourth step is an **analysis of this information** with the purpose of structuring the intellectual underpinning of the rest of the Goldenworkers' project. One of the main contributions of Goldenworkers is provide a way of thinking about ageing at work. Existing frameworks have dealt with ageing from a much broader perspective and thus emphasizing other aspects of aged life such as health, independent living, or care giving. Ageing at work is a very specific aspect of ageing, with specific challenges often closer to the challenges of other groups such as young parents than to the challenges of retired people. This analysis brings together information from the broader society forces, management demands, and ICT alternatives to develop a specific framework.

The last step presents the **framework** that brings together ICT state of the art and future trends, management requirements for goldenworkers, and society trends. The objective of the framework is to structure future discussions of ageing at work and in particular the effect of ICT.

## 3. The Phenomenon of Ageing

**Demography**

- Currently observed trends in population ageing are unprecedented.
- The population of older persons is itself ageing. Among those aged 60 years or over, the fastest growing population is that of the oldest old, that is, those aged 80 years or over.
- Europe is currently the major area with the highest proportion of older persons and is projected to remain so until 2050. Nearly 34 % of the population in Europe is projected to be 60 years or over in 2050, up from 22 % in 2009.
- Studies on the health status of the older population reveals that even if the rate of disabilities across older adults have decreased, the number of years Europeans can expect to live in poor health remains substantial.
- Data also reveals that the incidence of chronic diseases dramatically increase with age – in particular dramatic increases are observed as individuals reach age 70.
- Socioeconomic status of older individuals is correlated with health conditions. On average, older adults with lower income, less wealth, lower health-related quality of life, and lower occupational status, have worse health, greater disability, lower health related quality of life, worse mental health, and earlier mortality.
- It is hypothesized that education provides a set of psychological and cognitive skills that facilitate better health.
- Higher educational background is heavily associated with health and employment in older ages.

**Economic**

- Governments will face in the near future dramatic challenges to meet their social security obligations associated with pensions and health.
- Policy changes are being implemented to reduce this huge unfunded liabilities embedded in the current system.
- Lower social security is associated with higher risk of old-age poverty.
- Rising healthcare costs are putting additional pressure on the current social security systems.

**Labour**

- Labour force participation of those 50 years or over has being reduced dramatically in Europe in the last decades. Evidence exists that this trend has started to reverse.
- Projections indicate that the workforce will age, and there will be a shortage of young workers in many countries in Europe. Global enterprises will not be able to recruit young people in same way as at the end of the 1990s since the number of young workers will also decrease in the developing countries, where there will also be a growing need for them.
- Demand for high qualification is on the rise while the demand for low qualification is decreasing. Unemployment is highly correlated with education.
- Overall a “large unused labour capacity” exists in Europe, i.e. a large proportion of those who are retired are not affected by disabilities that would prevent them from working.
- Mature entrepreneurs are an employment option of choice for ageing people. A large portion of entrepreneurs are older people.
- Entrepreneurs’ most important motivations to start their own start up are being own boss, making money, new challenges, avoid unemployment, and work-life balance.

**Socio-cultural**

- Incentives embedded in pension systems shape individuals decision to leave the labour market and affect retirement behaviour.
- Decisions to retire are influenced by several factors. Different categories of incentives (negative and positive) and labour force participation interact in complex ways that confound direct causality.

- **Health and labour market status of an individual's spouse have a significant impact on individual's decision to retire.**
- **Because of the number of factors affecting individuals' decision to retire, it is suggested that incentives to keep working are rarely a sufficient solution to early retirement, but they are almost certainly a necessary part of the solution.**
- **Agreeable workplace conditions support later retirement.**
- **There is a strong embedded bias in society against employing older people without any empirical evidence.**
- **Socio-cultural changes are redefining the way people relate to work and organizations**

**Policy**

- **The Union has set five ambitious objectives to be reached by 2020: (1) employment, (2) innovation, (3) education, (4) social inclusion and (5) climate/energy.**
- **The European Employment Strategy encourages new skills for new jobs around equipping people with the right skills, improving quality of jobs and working conditions, flexicurity, and improving job creation.**
- **Key competencies for everyone to have include: (1) mother tongue literacy, (2) numeracy, (3) knowledge of foreign languages, (4) science and IT skills, (5) learning to learn, (6) social and civic competence, (7) initiative-taking and entrepreneurship, and (8) cultural awareness and self-expression.**
- **Flexicurity is designed to reconcile employers' need for a flexible workforce with workers' need for security and confidence that they will not face long periods of unemployment.**
- **Pension reform is being analysed to insure sustainable systems that insure incomes in old age, balance between work and retirement, and robust pensions.**
- **Europe 2012 is the year of Active Ageing and Solidarity between Generations.**
- **Policy-wise there is substantial room for promoting goldenworkers**

Population aging is a **global phenomenon**. The concept of "Active Ageing" was first introduced in 2002 at the Second World Assembly on Ageing organized by United Nations. The Assembly stated that the global ageing is an unprecedented all pervasive, profound new phenomenon and enduring change.

The proportion of people over 65 of age will increase up to 20 % by the year 2020, where as in 2000 it was 10 % of the population. In developed regions such Europe the increase is estimated to be even larger, as up to 33 % of the population will reach the age of 60 by the year 2050. There are several reasons for the rapid change of age structure of the society. The population in Europe has been regenerating for almost a decade and the number of 0-4 –year-old children will decline in every European country except Ireland. The **reduction of fertility** rates have gone down from 2.7 in 1965 to 1.5 in 1995.[i]

In the same time frame, the life expectancy has increased by 1 year every decade. The current life expectancy in Europe is 75 for men and 81 for women. In Japan it is even slightly higher and in the USA slightly lower. The largest proportion of people over 65 years in Europe at present is in Germany, and the smallest is in Ireland (2003). Population of Finland will age faster than in any other European country, and by 2020 Finland will have the largest proportion of people over 65. In general the population of elderly people will be proportionally larger in EU15 countries than in EU25 countries. At the same time as **lifespan has extended**, the **number of good functional years has also increased**. However, the length of their work life has not gone up as much. People retire on average at 61.

Thus, global ageing will affect work life in many ways. The workforce itself will age. In coming years, there will be more people retiring than entering the labour force and the overall average age of work force will be older than ever before. There will be **shortage of young workers** in many countries. **People retire too early in contradiction to dependency rates, growth of retirement and healthcare costs**. All these changes cause serious economic and social implications for European countries. Therefore, it is necessary to create positive attitudes and new ways of working towards a longer work life of individuals.

The effect of the few last work years has a great effect on people's retired life as well. Good

work ability means also a **good functional capacity** and **health**. Therefore these aspects should not be separated from one another.

The phenomenon of active ageing and the goal of good life became into general awareness in the 1980's, when harmony between the individual's choices and demands and the resources offered by the environment was first considered. The environmental issues were not in the general awareness yet, and people aimed at better quality of life and standard of living. The nature was believed to be in balance and people began to pursue good and healthy life as a goal that everyone desires. An active ager is a person who:

- is able to constantly develop her (his) **physical activity**,
- takes care of the **cognitive abilities** such as the faculty of problem solving, conceptual processing and linguistic abilities,
- takes actively part in **social activities** such as social networks, meaningful activity, hobbies and communities.

The active ageing model of successful ageing emphasizes that all of these criteria must be satisfied in order to achieve successful ageing. (Koskinen, 2006). In this model, successful ageing is seen as the **main responsibility of the individual**. In "courageous ageing" a person is a constantly developing individual and ready to meet challenges in all periods of life.

Good life is defined as four dimensions:

- mental well-being,
- experienced quality of life,
- competent behaviour,
- objective environment.

**Good work ability means also a good functional capacity and health**

Furthermore, successful ageing is defined as having good health and physical functional capacity. According to WHO (2000) when active ageing is supported both in the individual and population level, there will potentially be:

- fewer premature deaths during the highly productive stages of life,
- fewer disabilities associated with chronic diseases in older age,
- more people participating actively as they age in the social, cultural, economic and political aspects of society, in paid and unpaid roles and in domestic, family and community life.

Active living improves **mental health** and often promotes **social contacts**. Being active can help older people remain as independent as possible as long as possible. There as thus important economic benefits about older adults being active (WHO, 1998)

Each generation has its own individual characteristics. The environment and the features of the surrounding society have effects on each generation, and these consequences should be taken under consideration when defining characteristics of different generations. Work life lasts for decades, and therefore different phases of life should be taken under consideration when changes – or especially lengthening – of work life are considered.

The baby boomers (born 1945-1954) cohort is changing its attitude towards ageing because of their different values and expectations of life. They aim at retiring relatively young and have also different expectations of their "third life" than the previous cohort. Active ageing means the activity and participation outside the work life. They identify their **right to dependency** from other people as their human right, and to be able to rely on it when their own capacities are not sufficient. They also consider ageing to be a positive experience for them (WHO, 2002). The aim of improving the health and quality of life of people of the third age (55-80) is a centric goal of the near future. However, in the meantime there is a need to create positive attitudes and new ways of working towards a **longer work life of these healthy individuals**.

Human life is divided in different phases of life. These phases are defined in different perspectives, such as in biological, economical or in psychological. Each perspective emphasizes different aspects towards life. Work life is, however, one of the longest human life trajectories. Changes in person's health, functional capacity and life situation speed up the changes in attitudes towards work and retirement.

Tirrito (2003) defines courageous ager by her ability to meet the challenges in all periods of life and divides the life into five stages:

- the complacency phase (the so-called middle-age 45-54)
- the transience phase (55-64)
- early old age (65-74)
- the middle old age (74-85)
- the old-old age (85 and older).

However, there is a risk that successful ageing will be defined only to people in good

health, where as dignity, respect, autonomy and social engagement should also be seen as essential ingredients of the "good life". Have a possibility to work plays a significant role on individuals' dignity and self respect in case of willingness to work in the ageing years, if staying healthy.

## 3.1 Demography

### 3.1.1 Global Ageing

In recent years, studies in demography have been shown a growing concern for **population ageing** defined as the growth in the proportion of a population that is above a critical age (Martin, 2011).

According to the United Nation Population Division (UN, 2010a) a population is considered to be ageing when increases in the proportion of older persons are accompanied by reductions in the proportion of children (typically persons under age 15) and then by the decline in the proportions of persons in the working ages (15 to 59). Three core demographic determinates are at the basis of demographic changes associated with population ageing. These are: **fertility rates**, **mortality rates** and **migration** (Coale, 1956; Martin, 2011). In the past 50 years, decreasing fertility along with increasing in life expectancy have reshaped the age structure of the population in most regions of the planet by shifting the relative weight of the population from younger to older groups.

Current trends in population ageing are unprecedented. These trends have characterized the past century and are expected to continue for another half century at least (UN, 2010a). From 1950 to 2000 the number of people aged 65 or older has tripled from 131 million to 417 million, and is expected to reach 1,468 millions 2050, increasing from 5.2 to 6.8 % up to 16.2% of the whole world population in 1950, 2000 and 2050 respectively (**Table 1**).

**Table 1: Population aged 65 or more for the world**

| Year | Millions | % of total population |
|---|---|---|
| 1950 | 130.5 | 5.2% |
| 2000 | 417.2 | 6.8% |
| 2050 | 1,486.9 | 16.2% |

*Source: Martin, 2011. Data from United Nations Population Division, 2009, medium variant.*

The consequences of population ageing are profound, having major implications in **economic** (e.g., savings, investments, consumptions, labour markets), **social** (e.g., family composition, living arrangements, housing demands) and **political** terms (e.g., voting patterns) (see UN, 2010a for a general discussion of the socio/economic implications of population ageing).

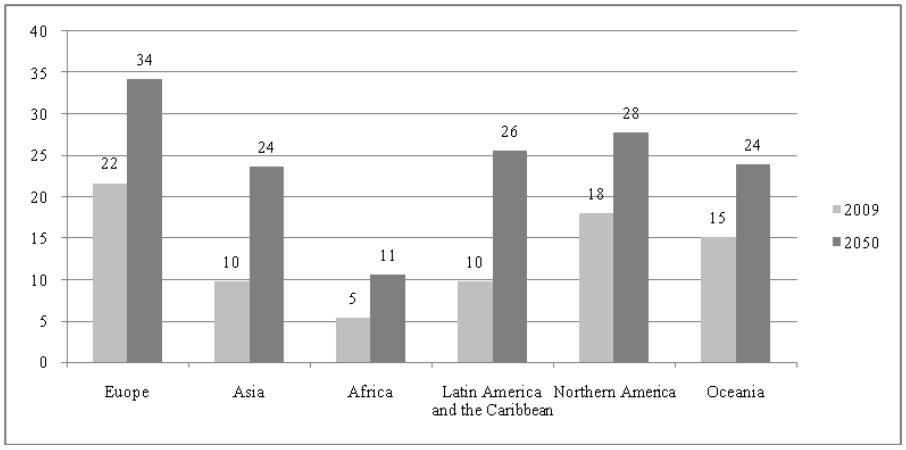
Perhaps the most critical aspect of population ageing is that the changing balance between age groups **undermines the long term viability of intergenerational social support systems** (e.g., pensions and demand for health services) in particular, under pay-as-you go schemes where taxes on current workers pay the pensions and social security of retirees. Important social implications are associated, in particular considering the role of intergenerational social support systems for the well being of both younger and older generations (Cliquet & Nizamuddin, 1999).

While population ageing is a global phenomenon, significant geographic differences exist. At a broadest level, these differences exist across more developed and less developed countries (**Figure 2**), with populations generally older in more developed countries. These countries were characterized, in the late nineteenth century, by a combination of public health improvements coupled with a set of socioeconomic factors – namely, improved standards of living, hygiene, and nutrition (Coale, 1987; Omran, 1971; Martin, 2011).

**Figure 3** shows the percentage of the population over 60 years of age in 200 across the world.

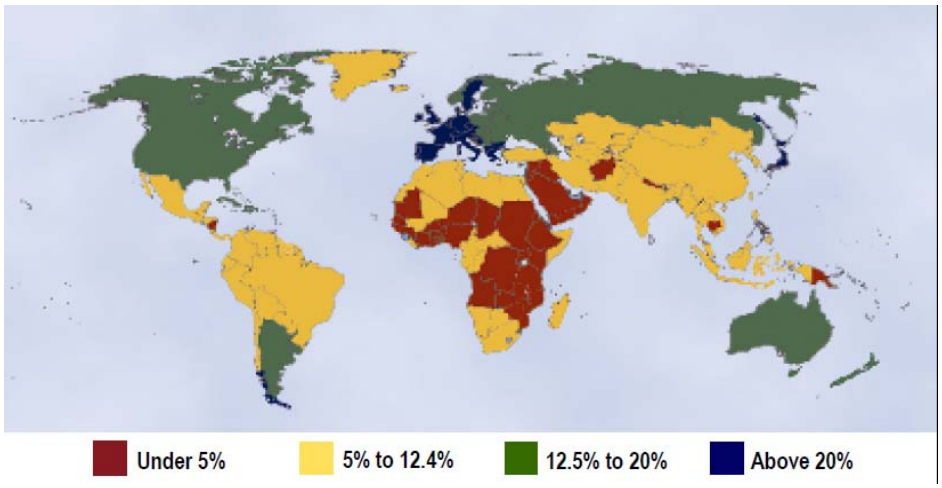
Even if more developed countries are older and expected to remain so for few more decades, other countries, particularly Asian and Latin American Countries, are projected to be ageing at a higher rate (**Figure 4**).

**Figure 2: Percent of total population aged 60 and over by major region 2009 2050**



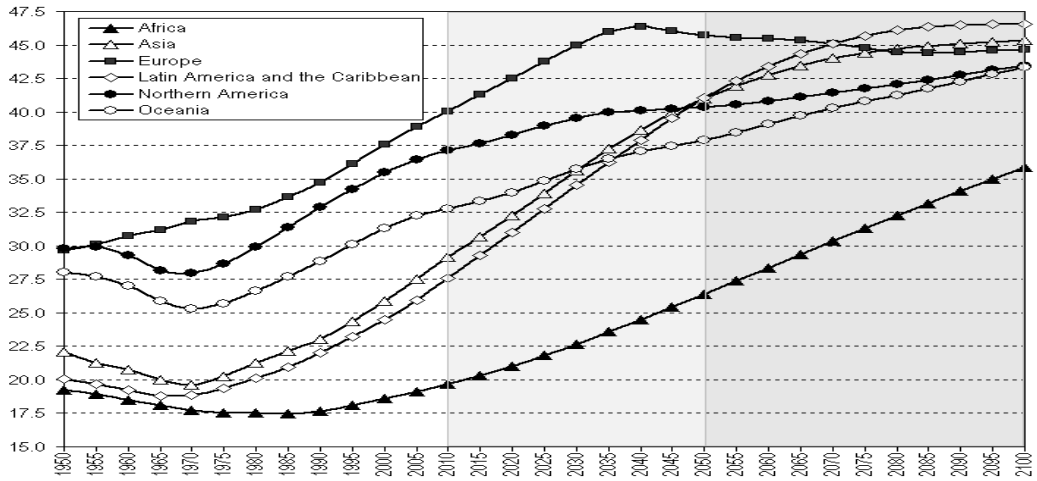

*Source: Author's graph, based on data from UN (2011)*

**Figure 3: Population aged 60+ in 2000**




*Source: U.S. census bureau*

**Figure 4: Median age of the population by major region (years)**




*Source: United Nations, Department of Economic and Social Affairs, Population Division UN (2010b)*

### 3.1.2 MEASURING GLOBAL AGEING

Several indicators are used to measure (global) population ageing. **Table 2** reports the value for selected indicators grouped around major areas and regions. The simplest indicators simply report **indicative age groups as a percentage of the total population**.

Another commonly used indicator is represented by the **median age**. The median age of a population is the age that divides a population into two groups of the same size, such that half the total population is younger than this age, and the other half older.

Under the label **dependency ratio** (DR) are included a series of indicators used to compare the **proportion of younger or older population at prime working ages**. These indicators are typically labelled dependency ratio because they are rough indicators of the extent to which one group in a population is dependent on another group (See Martin, 2011 for a discussion of issues associated with this interpretation of the indicator).

The **old age dependency ratio** (OADR) represents the ratio of the population aged 65 and over, to the population aged 20-64. Because 65 represent the typical retirement age in many countries and 19 years represent the average age of completion of high school – which has become the norm in richer countries – the OADR is often used as an indicator of the extent to which the older population is dependent on the younger.

Other dependency ratio indicators commonly used are the **Total DR** and the **youth Dependency Ratio**. The total dependency ratio (TDR) is the number of persons under age 15 plus persons aged 65 or over per one hundred persons 15 to 64. It is the sum of the youth dependency ratio and the old-age dependency ratio. The youth dependency ratio (YDR) is the number of persons 0 to 14 years per one hundred persons 15 to 64 years.

The **potential support ratio** (PSR), that is, the number of persons aged 15 to 64 for each person aged 65 years or over, indicates how many potential workers there are per older person. As population ages the potential support ratio tend to fall. A recent report from the United Nations Population Division highlights that between

1950 and 2009 the potential support ratio decline from 12 to 9 workers per person aged 65 or over, and is projected to reach 4 potential workers per older person by 2050 (UN, 2010a).

Other useful indicators are **Sex Ratios** and **Growth Rate**. The sex ratio is calculated as the number of males per one hundred females in a population. The sex ratio may be calculated for a total population or for a specific age group.

A population's growth rate is the increase (or decrease) in the number of persons in the population during a certain period of time, expressed as a percentage of the population at the beginning of the time period.

Because the meaning of chronological age changes as a consequence of an increase in life expectancy, better indication of demographic changes can be obtained by analyzing traditional dependency ratio (e.g., OADR) with measures of prospective ageing (Sanderson & Schrbov, 2005, 2007, 2008). **Measures of prospective ageing** can be used to compare ageing in population with different life expectancies.

For example, because the probabilities of need for care from both formal and informal sources are likely greatest in the last part of life, indicators measuring the proportion at or above the age at which remaining life expectancy (RLE) is a particular number of years, are insightful, in particular for policy making. As **Figure 5** shows, there can be significant differences in life expectancy even within the same macro geographic region.

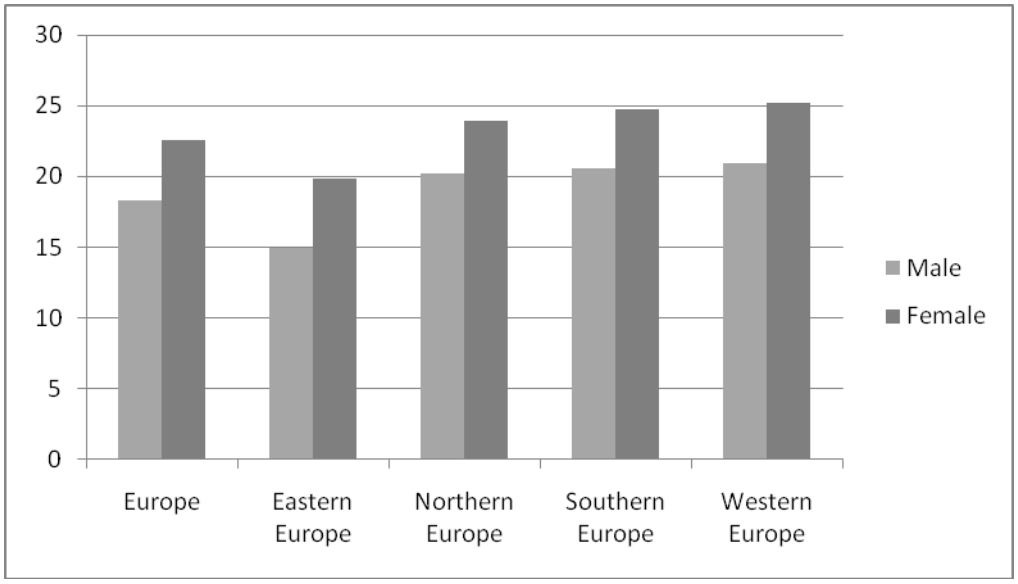
**Table 2: Selected Indicators on Ageing– World, Major Areas and Regions**

| Major areas and regions | Broad age groups (*percentage*) 0-14 | 15-59 | 60+ | Median age | Dependency ratios Total | Youth | Old-age |
|---|---|---|---|---|---|---|---|
| World | 27.2 | 62.0 | 10.8 | 28.1 | 53.1 | 41.6 | 11.5 |
| More developed regions | 16.6 | 62.0 | 21.4 | 39.6 | 47.8 | 24.5 | 23.3 |
| Less developed regions | 29.5 | 62.0 | 8.5 | 25.9 | 54.3 | 45.6 | 8.8 |
| Least developed countries | 40.1 | 54.7 | 5.1 | 19.6 | 76.8 | 71.0 | 5.8 |
| Africa | 40.4 | 54.2 | 5.3 | 19.4 | 78.1 | 72.0 | 6.1 |
| Eastern Africa | 43.9 | 51.4 | 4.7 | 17.7 | 88.4 | 82.7 | 5.7 |
| Middle Africa | 44.9 | 50.6 | 4.5 | 17.2 | 91.4 | 85.9 | 5.5 |
| Northern Africa | 31.7 | 61.2 | 7.0 | 23.9 | 57.0 | 49.8 | 7.2 |
| Southern Africa | 31.3 | 61.7 | 7.0 | 24.1 | 55.6 | 48.8 | 6.9 |
| Western Africa | 42.7 | 52.5 | 4.8 | 18.3 | 84.2 | 78.7 | 5.6 |
| Asia | 26.5 | 63.8 | 9.7 | 28.1 | 49.5 | 39.7 | 9.8 |
| Eastern Asia | 19.5 | 67.0 | 13.5 | 34.8 | 40.5 | 27.4 | 13.1 |
| South-Central Asia | 31.7 | 61.2 | 7.1 | 24.2 | 57.2 | 49.8 | 7.3 |
| South-Eastern Asia | 27.6 | 63.9 | 8.5 | 27.2 | 50.1 | 41.4 | 8.7 |
| Western Asia | 31.8 | 61.3 | 6.9 | 24.6 | 57.5 | 50.1 | 7.4 |
| Europe | 15.4 | 62.9 | 21.6 | 40.1 | 46.1 | 22.5 | 23.6 |
| Eastern Europe | 14.7 | 66.3 | 19.0 | 38.3 | 40.0 | 20.6 | 19.5 |
| Northern Europe | 17.4 | 60.3 | 22.3 | 39.6 | 50.7 | 26.2 | 24.5 |
| Southern Europe | 15.0 | 61.5 | 23.5 | 40.9 | 49.1 | 22.4 | 26.7 |
| Western Europe | 15.8 | 60.2 | 23.9 | 42.1 | 51.6 | 24.0 | 27.5 |
| Latin America and the Caribbean | 28.1 | 62.1 | 9.8 | 27.2 | 53.5 | 43.1 | 10.4 |
| Caribbean | 26.9 | 61.3 | 11.8 | 28.5 | 54.2 | 41.4 | 12.8 |
| Central America | 30.5 | 60.8 | 8.6 | 25.5 | 57.7 | 48.1 | 9.6 |
| South America | 27.3 | 62.7 | 10.0 | 27.8 | 51.9 | 41.4 | 10.5 |
| Northern America | 20.0 | 62.0 | 18.0 | 36.8 | 48.9 | 29.7 | 19.2 |
| Oceania | 24.4 | 60.6 | 15.1 | 32.3 | 53.8 | 37.5 | 16.3 |
| Australia/New Zealand | 19.3 | 61.8 | 18.9 | 37.4 | 48.7 | 28.6 | 20.1 |
| Polynesia | 32.6 | 59.3 | 8.1 | 23.6 | 61.7 | 52.7 | 8.9 |
| Melanesia | 38.5 | 56.7 | 4.8 | 20.6 | 70.5 | 65.6 | 5.0 |
| Micronesia | 30.7 | 62.3 | 7.1 | 25.3 | 54.1 | 47.2 | 6.8 |

| Potential support ratio | Sex ratios (*per 100 women*) 60+ | 65+ | 80+ | Growth rates (*percentage*) Total | 60+ | 65+ | 80+ | Major areas and regions |
|---|---|---|---|---|---|---|---|---|
| 8.7 | 83.5 | 79.0 | 58.9 | 1.2 | 2.6 | 2.0 | 4.0 | World |
| 4.3 | 74.0 | 68.9 | 49.3 | 0.3 | 1.9 | 1.1 | 3.5 | More developed regions |
| 11.4 | 89.3 | 85.8 | 70.3 | 1.4 | 3.0 | 2.6 | 4.5 | Less developed regions |
| 17.2 | 85.4 | 83.4 | 74.0 | 2.3 | 2.9 | 2.9 | 3.8 | Least developed countries |
| 16.5 | 84.6 | 81.6 | 68.4 | 2.3 | 3.0 | 2.8 | 4.0 | Africa |
| 17.5 | 82.7 | 81.0 | 71.0 | 2.6 | 3.0 | 2.9 | 4.0 | Eastern Africa |
| 18.1 | 81.8 | 79.1 | 65.3 | 2.6 | 2.4 | 2.5 | 2.8 | Middle Africa |
| 13.9 | 88.5 | 84.4 | 70.9 | 1.7 | 3.4 | 2.4 | 4.9 | Northern Africa |
| 14.5 | 70.3 | 64.2 | 42.7 | 1.0 | 3.2 | 3.4 | 3.8 | Southern Africa |
| 18.0 | 88.2 | 85.8 | 73.7 | 2.5 | 2.7 | 3.0 | 3.5 | Western Africa |
| 10.2 | 89.9 | 86.1 | 67.6 | 1.1 | 2.9 | 2.5 | 4.6 | Asia |
| 7.6 | 91.3 | 86.7 | 62.4 | 0.6 | 3.1 | 2.4 | 4.7 | Eastern Asia |
| 13.7 | 92.0 | 89.3 | 84.4 | 1.5 | 2.8 | 2.7 | 4.4 | South-Central Asia |
| 11.6 | 81.3 | 78.1 | 65.2 | 1.2 | 2.8 | 2.8 | 4.5 | South-Eastern Asia |
| 13.6 | 83.8 | 79.0 | 62.5 | 1.9 | 2.7 | 2.0 | 5.2 | Western Asia |
| 4.2 | 70.2 | 65.2 | 45.8 | 0.1 | 1.3 | 0.5 | 3.8 | Europe |
| 5.1 | 57.7 | 52.3 | 35.8 | -0.4 | 0.7 | -1.0 | 5.3 | Eastern Europe |
| 4.1 | 79.5 | 74.3 | 52.3 | 0.5 | 1.9 | 1.3 | 1.6 | Northern Europe |
| 3.7 | 77.0 | 72.6 | 53.8 | 0.5 | 1.6 | 1.2 | 4.1 | Southern Europe |
| 3.6 | 77.5 | 72.3 | 47.1 | 0.2 | 1.6 | 1.4 | 3.4 | Western Europe |
| 9.6 | 82.2 | 78.6 | 64.8 | 1.1 | 3.3 | 3.1 | 4.5 | Latin America and the Caribbean |
| 7.8 | 86.7 | 84.4 | 73.0 | 0.8 | 2.6 | 2.6 | 3.4 | Caribbean |
| 10.5 | 87.1 | 83.8 | 69.5 | 1.2 | 3.3 | 3.4 | 4.8 | Central America |
| 9.6 | 80.1 | 76.2 | 62.3 | 1.1 | 3.4 | 3.0 | 4.6 | South America |
| 5.2 | 80.2 | 75.5 | 56.5 | 1.0 | 2.7 | 1.9 | 1.9 | Northern America |
| 6.1 | 88.0 | 83.6 | 62.0 | 1.3 | 3.2 | 2.5 | 3.3 | Oceania |
| 5.0 | 87.5 | 83.1 | 61.6 | 1.0 | 3.1 | 2.5 | 3.3 | Australia/New Zealand |
| 11.2 | 89.8 | 85.0 | 56.8 | 0.8 | 2.2 | 2.6 | 3.4 | Polynesia |
| 20.2 | 93.3 | 89.9 | 76.4 | 2.2 | 3.9 | 3.5 | 4.2 | Melanesia |
| 14.6 | 89.3 | 82.4 | 67.7 | 1.3 | 4.3 | 2.5 | 1.7 | Micronesia |

*Data Source: United Nations (2010a).*

**Figure 5: Life Expectancy at Age 60 in Europe 2010**




**Eastern Europe** includes Bulgaria, Czech Republic, Hungary, Republic of Moldova, Poland Romania, Russian Federation, Slovakia, Ukraine.
**Northern Europe** includes Channel Islands, Denmark, Estonia, Faeroe Islands, Finland, Iceland, Ireland, Isle of Man, Latvia, Lithuania, Norway, Sweden, United Kingdom
**Southern Europe** includes Albania, Andorra, Bosnia and Herzegovina, Croatia, Gibraltar, Greece, Holy See, Italy, Malta, Montenegro, Portugal, San Marino, Serbia, Slovenia, Spain, TFYR Macedonia.
**Western Europe** includes Austria, Belgium, France, Germany, Liechtenstein, Luxembourg, Monaco, Netherlands, Switzerland.

*Data Source: Authors' elaboration on United Nations Data (United Nations Population Division, 2010).*

**Several indicators are used to measure (global) population ageing: the dependency ratio, the old age dependency ratio, the total dependency ratio, the youth ratio, the potential support ratio, sex ratios and growth rate**

The notion of prospective ageing can be used in combination with other indicators. For example, when prospective ageing is used in combination with OADR, a new indicator can be defined, POADR (where P stands for prospective) where the lower boundary of old age is defined as the age at which there are a given number of remaining years on average. Martin (2011) notes that using the POADR instead of the traditional OADR changes the ranking of oldest countries.

### 3.1.3 Demographic Profile of Older Population

Because the need for assistance and risk of (chronic) health problems typically increase with age, there is particular interest in changes in population proportions at ages more advanced than 65 (or 60). Ages such 80 or 85, often referred to as "**oldest old**", are typically analyzed and used in studies on the socio-economic implications of population ageing.

Recent studies in demographic change have revealed that the **population of older persons is itself ageing**. Among those aged 60 years or over, the fastest growing population is that of the oldest old, that is, those aged 80 years or over. The share of persons 80 years or over is expected to increase significantly from 2009 to 2050 worldwide, albeit significant differences exist among developed and developing countries (See **Table 3**).

**Table 3: Share of persons 80 years (of people over 60) or over by macro geographic areas**

| | 2009 | 2050 |
|---|---|---|
| World | 14 | 20 |
| More developed countries | 20 | 29 |
| Less developed countries | 11 | 17 |
| Least developed countries | 8 | 10 |

*Data Source: United Nations Population Division, 2010.*

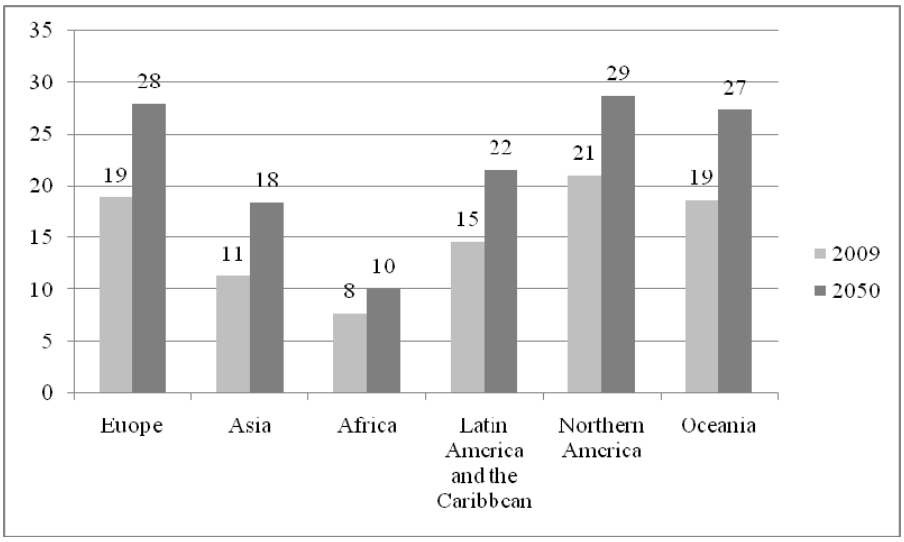
More developed regions comprise all regions of Europe and Northern America, Australia/New Zealand and Japan.
Less developed regions comprise all regions of Africa, Asia (excluding Japan) and Latin America and the Caribbean and the regions of Melanesia, Micronesia and Polynesia.
Least developed countries as defined by United Nations General Assembly, as of 2009, include 49 countries, of which 33 are in Africa, 10 are in Asia, 1 is in Latin America and the Caribbean and 5 are in Oceania. The least developed countries are included in the less developed regions.

**Figure 6** illustrates graphically the ageing trends (2009-2050) in the old population and the differences in major geographic areas. More developed regions have the higher share of oldest old, and their populations are projected to remain considerably older than those of developing countries as a whole. According to Martin (2011), for the more developed countries, the population is projected to increase at a rate of 2,3% annually from 2000 to 2050, even as their total population grow at a rate of only 0,1% annually and the population aged 65 and over grows at 1,3% annually. If this rapid rate of growth is sustained, the number of oldest old will double in just 30 years.

According to UN population division (2010a) the **older population is growing faster than the total population** in practically all regions of the world and the difference in growth rates is increasing. At the global level, 8% of the population was at least 60 years of age in 1950, and 5% was at least 65 years of age. By 2009, those proportions had increased to 11 % and just under 8%, respectively.

**Recent studies in demographic change have revealed that the population of older persons is itself ageing**

**Figure 6: Share of persons 80 years or over as percentage of the population over 60 by geographic regions: 2009-2050**




*Source: authors' graph based on data from United Nations Population Division, 2010a*

The number of people aged 80 years or over is currently growing at 4% per year. Today, persons aged 80 years or over account for close 1 in every 7 older person (60 or over). By 2050, this ratio is expected to increase to nearly 1 person aged 80 or over among every 5 older persons.

**Table 4** provides general indicators – including gender, marital status and employment conditions – that characterize the demographic profile of older population, differentiating across macro geographic areas.

**Gender indicators** (e.g., sex ratios) and **marital status** are important indicators for characterizing the composition of the older population since they affect the overall well being of old persons. For example, marital status can strongly affect the emotional and economic well/being of older persons, particularly those with an illness or disability, since marital status often determines living arrangements and the availability of caregivers.

In developed countries, where there is not systematic discrimination against females in terms of nutrition and access to healthcare, female mortality rates are less than male mortality rates at every age. Given that there are more old females than males in the developed regions (especially Europe), and given that husbands are typically older than their wives and thus at greater mortality risk, **females are less likely to be married**.

The extent to which an old person lives alone is another important indicator – partially influenced by marital status – as older persons living alone are at greater risk of **experiencing social isolation** and **economic deprivation**, and may therefore require special support. Data on the extent to which older persons tend to leave alone are reported in **Table 4**.

**Table 4: Global Demographic profile of older population**

| | Percentage of total population over 60 | | Share of persons 80 years or overii | | Sex ratio (men per 100 women), 2009 | | Life expec-tancy at age 60, 2005-2010 | Percentage currently mar-ried, 60 years or overiii | Percentage liv-ing alone, 60 years or over | Old-age support ra-tioiv | | Percentage in labour force, 60 years or overv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Geographic Area | 2009 | 2050 | 2009 | 2050 | 2009 | 2050 | Men / Women | Men / Women | Men / Women | 2009 | 2050 | Men / Women |
| World | 11 | 22 | 14 | 20 | 83 | 59 | 18 / 21 | 80 / 48 | 9 / 19 | 9 | 4 | 40 / 20 |
| Euope | 22 | 34 | 19 | 28 | 70 | 46 | 18 / 23 | 77 / 44 | 14 / 34 | 4 | 2 | 18 / 10 |
| Asia | 10 | 24 | 11 | 18 | 90 | 68 | 18 / 20 | 81 / 52 | 6 / 11 | 10 | 4 | 44 / 23 |
| Africa | 5 | 11 | 8 | 10 | 85 | 68 | 15 / 17 | 85 / 39 | 6 / 11 | 16 | 9 | 61 / 34 |
| Latin America and the Caribbean | 10 | 26 | 15 | 22 | 82 | 65 | 20 / 22 | 76 / 43 | 9 / 12 | 10 | 3 | 47 / 21 |
| Northern America | 18 | 28 | 21 | 29 | 80 | 57 | 21 / 25 | 75 / 47 | 15 / 34 | 5 | 3 | 32 / 22 |
| Oceania | 15 | 24 | 19 | 27 | 88 | 62 | 21 / 25 | 73 / 50 | 16 / 34 | 6 | 3 | 30 / 18 |

*Source: Author's table based on data from United Nation Population Division, available at:* ***http://esa.un.org/unpd/wpp/Excel-Data/population.htm***
**Eastern Europe** includes Bulgaria, Czech Republic, Hungary, Republic of Moldova, Poland Romania, Russian Federation, Slovakia, Ukraine.
**Northern Europe** includes Channel Islands, Denmark, Estonia, Faeroe Islands, Finland, Iceland, Ireland, Isle of Man, Latvia, Lithuania, Norway, Sweden, United Kingdom
**Southern Europe** includes Albania, Andorra, Bosnia and Herzegovina, Croatia, Gibraltar, Greece, Holy See, Italy, Malta, Montenegro, Portugal, San Marino, Serbia, Slovenia, Spain, TFYR Macedonia.
**Western Europe** includes Austria, Belgium, France, Germany, Liechtenstein, Luxembourg, Monaco, Netherlands, Switzerland.

### 3.1.4 DEMOGRAPHIC CHANGE

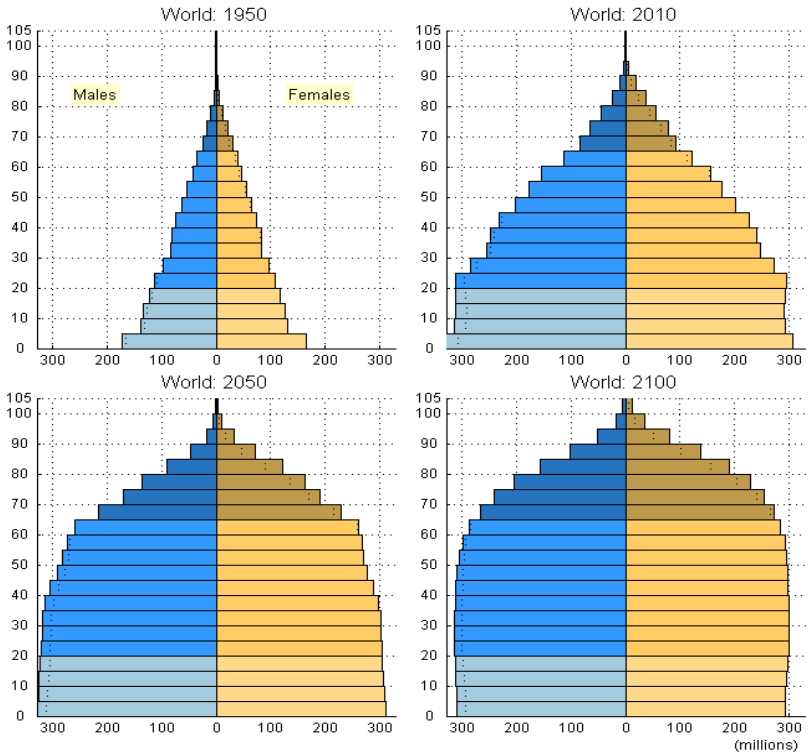
Population ageing is better understood in the broader domain of demographic change, which represents the change in the composition of a population, in terms of age stratification or spectrum.

As population ages, its demographic structure shifts. The importance of analyzing the phenomena of ageing with respect to entire demographic shifts arises from considering that assessment of economic impact of changes in a given age strata, assume full meaning in relationship to the entire configuration within the demographic composition of a population.

Evolutionary trends associated with ageing are typically captured graphically by mean of population pyramids. Population pyramids presents graphically the proportion of the population at each age. As a population ages, these graphs change shape from a pyramid to a rectangle. Figure 7 shows population pyramids for world population.

Population pyramids for different countries are available on the United Nations Department of Economic and Social Affairs web site.vi

**Figure 7: World Population Pyramids**




Note: The dotted line indicates the excess male or female population in certain age groups. Age groups are in thousands or millions.

*Source: United Nations, Department of Economic and Social Affairs, UN (2010b).*

### 3.1.5 DEMOGRAPHIC PROFILE OF THE OLDER POPULATION IN EUROPE

Europe is currently the major area with the highest proportion of older persons and is projected to remain so until 2050 (see **Figure 1**). Nearly 34 % of the population in Europe is projected to be 60 years or over in 2050, up from 22 percent in 2009. In contrast only 11% of the population of Africa is projected to be 60 or over in 2050, up from 5% in 2009.

**Table 5** provides a general overview of the demographic profile of older population in Europe (EU 27).

**Table 5: Demographic profile of European population aged 60 years and over (2009-2050)**

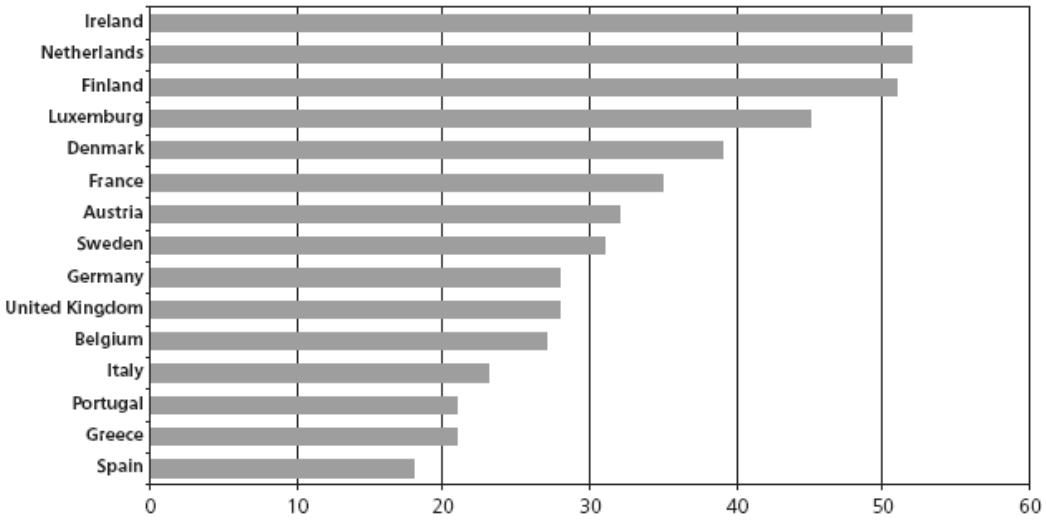
| | Number (thousands) | | Percentage of total population | | Share of persons 80 years or over | | Sex ratio (men per 100 women) | | Life expectancy at age 60, 2005-2010 | | Percentage currently married, 60 years or over | Percentage living alone, 60 years or over | Old-age support ratio | | Percentage in labour force, 60 years or over |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2009 | 2050 | 2009 | 2050 | 2009 | 2050 | 2009 | 2050 | Men | Women | Men / Women | Men / Women | 2009 | 2050 | Men / Women |
| Bulgaria | 1 824 | 2 059 | 24 | 38 | 15 | 22 | 72 | 54 | 16 | 20 | 79 / 47 | 12 / 25 | 4 | 2 | 16 / 6 |
| Czech Republic | 2 255 | 3 547 | 22 | 34 | 16 | 23 | 73 | 44 | 18 | 22 | 77 / 45 | 17 / 40 | 5 | 2 | 16 / 5 |
| Hungary | 2 212 | 2 952 | 22 | 33 | 17 | 21 | 63 | 42 | 16 | 21 | 74 / 36 | 13 / 32 | 4 | 2 | 11 / 4 |
| Poland | 7 174 | 12 175 | 19 | 38 | 17 | 22 | 66 | 43 | 17 | 23 | 80 / 41 | 10 / 28 | 5 | 2 | 13 / 5 |
| Romania | 4 256 | 6 391 | 20 | 37 | 15 | 20 | 72 | 55 | 16 | 20 | 81 / 44 | 6 / 15 | 5 | 2 | 17 / 15 |
| Slovakia | 933 | 1 780 | 17 | 36 | 16 | 21 | 66 | 43 | 17 | 21 | 82 / 42 | 11 / 30 | 6 | 2 | 9 / 3 |
| Cyprus | 33 | 52 | 22 | 36 | 17 | 33 | 84 | 54 | 20 | 23 | .. | .. | 5 | 2 | 19 / 11 |
| Denmark | 1 258 | 1 626 | 23 | 29 | 18 | 31 | 83 | 53 | 20 | 23 | 70 / 49 | 25 / 50 | 4 | 3 | 25 / 12 |
| Estonia | 301 | 393 | 22 | 32 | 18 | 23 | 55 | 31 | 16 | 22 | 71 / 33 | 19 / 41 | 4 | 2 | 32 / 25 |
| Finland | 1 280 | 1 736 | 24 | 32 | 19 | 32 | 77 | 45 | 20 | 25 | 69 / 44 | 21 / 45 | 4 | 2 | 22 / 14 |
| Ireland | 717 | 1 894 | 16 | 30 | 17 | 24 | 86 | 54 | 20 | 24 | 67 / 47 | 20 / 30 | 6 | 2 | 29 / 13 |
| Latvia | 505 | 643 | 22 | 35 | 17 | 22 | 53 | 29 | 16 | 21 | 69 / 34 | 13 / 27 | 4 | 2 | 37 / 19 |
| Lithuania | 699 | 870 | 21 | 34 | 17 | 25 | 56 | 35 | 16 | 21 | 75 / 39 | 14 / 35 | 4 | 2 | 19 / 8 |
| Sweden | 2 283 | 3 192 | 25 | 30 | 22 | 31 | 84 | 56 | 21 | 25 | 65 / 46 | 24 / 47 | 4 | 2 | 31 / 21 |
| United Kingdom | 13 813 | 20 869 | 22 | 29 | 21 | 30 | 81 | 54 | 20 | 24 | 73 / 47 | 22 / 45 | 4 | 3 | 24 / 12 |
| Greece | 2 678 | 4 113 | 24 | 38 | 15 | 28 | 82 | 77 | 21 | 23 | 85 / 52 | 8 / 23 | 4 | 2 | 15 / 6 |
| Italy | 15 788 | 22 310 | 26 | 39 | 22 | 34 | 76 | 51 | 22 | 26 | 82 / 49 | 10 / 32 | 3 | 2 | 12 / 3 |
| Malta | 87 | 152 | 21 | 37 | 16 | 26 | 81 | 52 | 21 | 24 | 66 / 37 | .. | 5 | 2 | 11 / 1 |
| Portugal | 2 497 | 3 848 | 23 | 38 | 19 | 29 | 75 | 53 | 20 | 24 | 81 / 49 | 9 / 21 | 4 | 2 | 32 / 20 |
| Slovenia | 442 | 724 | 22 | 37 | 18 | 28 | 69 | 36 | 19 | 24 | 77 / 47 | 11 / 31 | 4 | 2 | 13 / 6 |
| Spain | 9 982 | 19 235 | 22 | 38 | 22 | 30 | 78 | 55 | 21 | 26 | 80 / 49 | 7 / 19 | 4 | 2 | 16 / 6 |
| Austria | 1 912 | 3 049 | 23 | 36 | 21 | 34 | 75 | 45 | 21 | 25 | 76 / 41 | 15 / 40 | 4 | 2 | 10 / 3 |
| Belgium | 2 454 | 3 717 | 23 | 32 | 21 | 33 | 78 | 50 | 20 | 25 | 75 / 49 | 16 / 39 | 4 | 2 | 9 / 3 |
| France | 14 140 | 22 034 | 23 | 33 | 24 | 35 | 76 | 50 | 22 | 27 | 76 / 47 | 15 / 38 | 4 | 2 | 7 / 5 |
| Germany | 21 134 | 27 873 | 26 | 40 | 19 | 36 | 77 | 43 | 20 | 25 | 76 / 49 | 15 / 42 | 3 | 2 | 15 / 7 |
| Luxembourg | 92 | 196 | 19 | 27 | 19 | 28 | 80 | 46 | 20 | 24 | 77 / 45 | 14 / 35 | 5 | 3 | 5 / 3 |
| Netherlands | 3 548 | 5 445 | 21 | 31 | 18 | 33 | 83 | 50 | 21 | 24 | 76 / 52 | 17 / 42 | 4 | 2 | 19 / 9 |

*Data Source: United Nations Population Division, UN (2011)*

In Europe the proportion of people over 65 years of age has increased steadily during the last 10 years (**Figure 8 & 9**).

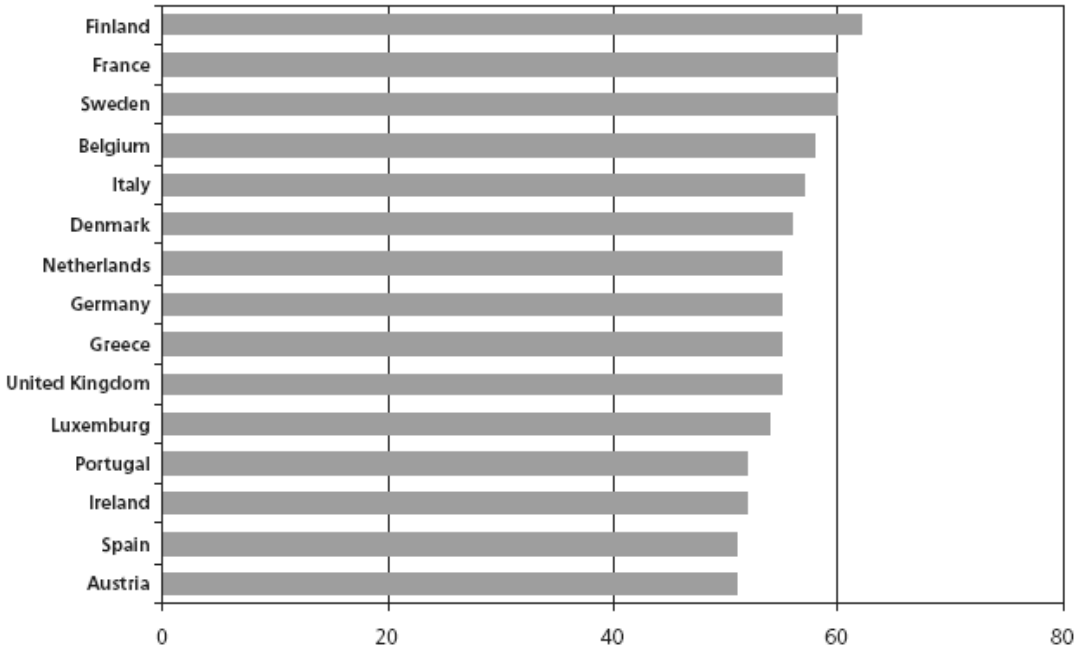
As **Table 5** and **Figure 8** and **9** show, significant differences exist among European countries. **Figure 10** shows the percentage of population aged 60 or over in EU 27, in 2009 and 2050. The figure also illustrates that differences in demographic distribution across EU 27 in 2009 will not be reflected in 2050 (i.e. the rate at which population is expected to age varies across EU 27). For example, while Italy will remain one of the oldest nations, Sweden, which in 2009 was among the oldest countries in Europe, will be ageing at a much slower rate, well below the average ageing rate.

**Figure 8: Change (%) in the number of people over 65 years of age in 2002–2020**



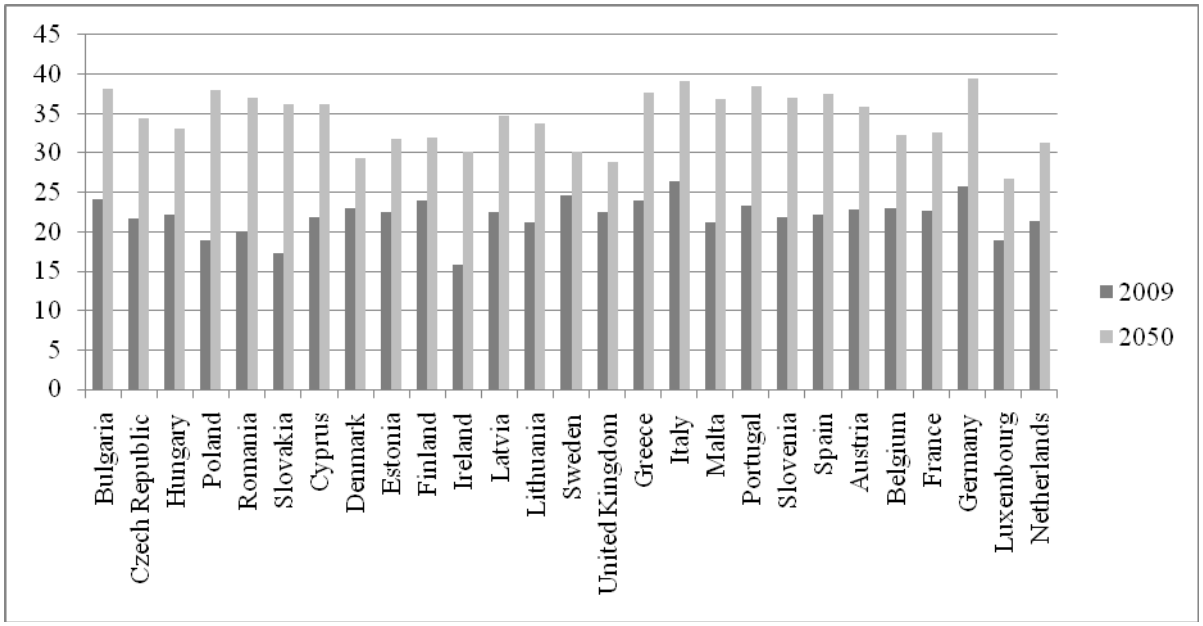

*Source Adapted from Illmarinen (2008)*

**Figure 9: Population-based dependency ratio for the EU15 countries in 2020 (age groups 0–14 and over 65 years to 100 15- to 64-year-olds)**




*Source: Illmarinen (2008)*

**Figure 10: Persons aged 60 or over as percentage of total population 2009 – 2050**



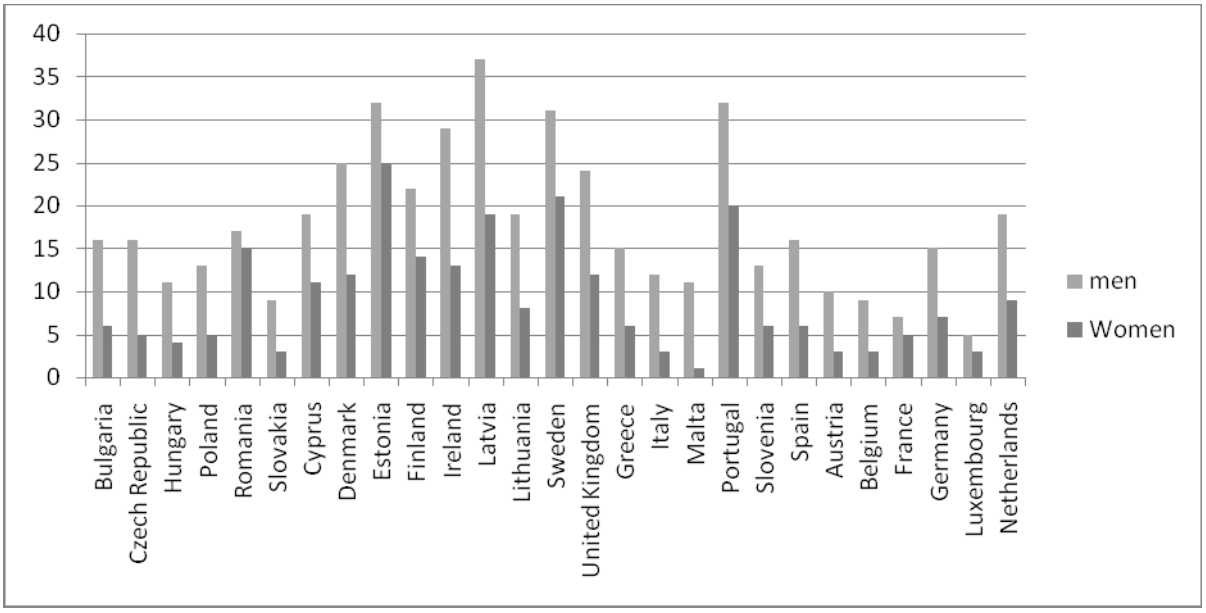

*Source: Authors' elaboration on data from*

People aged 80 or over currently comprise over 4 percent of the population of Europe, equivalent to 19 percent of the fraction of the population aged 60 years or over. **Women comprise the majority of the older population** (in 2009 there are 70 men every 100 women) and their share of the older population will increase with age. **Only 10 % of women** aged 60 years of over are in the **labour force**, while this percentage increases to 18% for men in the same group (**Table 5**). **Figure 11** illustrates the percentage of men and women aged 60 years or over in the labour force in EU 27.

While the majority of older men are currently married (77%) oldest women are not (56%). **Figure 12** shows information on marital status for the older population in EU 27.

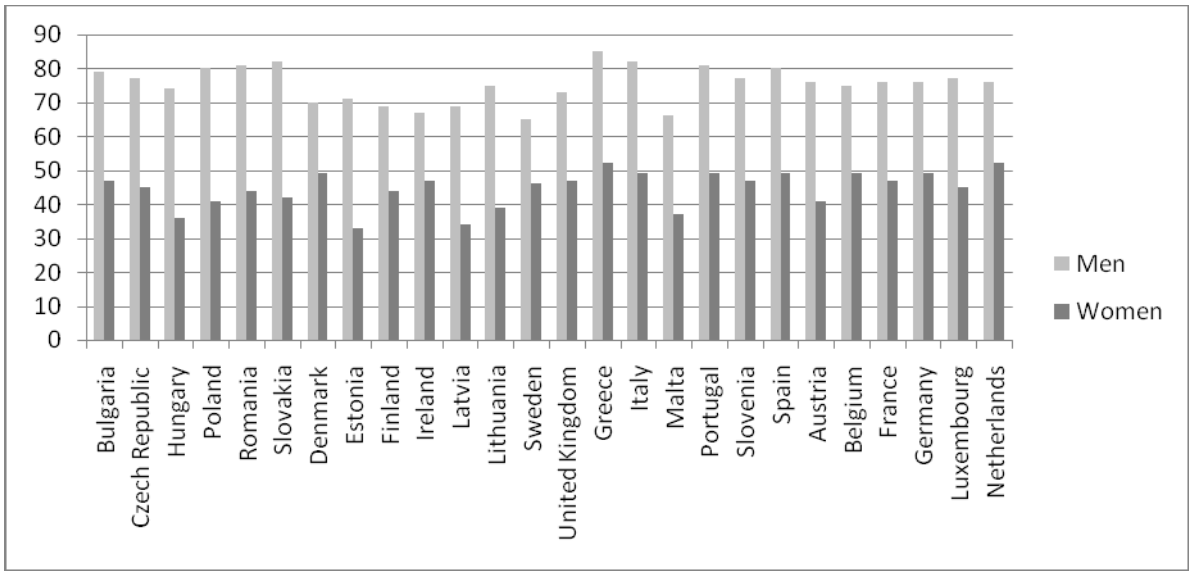
Among the older population the percentage of **women living alone** is significantly greater than men, and differences across countries exist (**Figure 13**).

**Figure 11: Percentages of people aged 60 years or over in the labour force in EU 27**



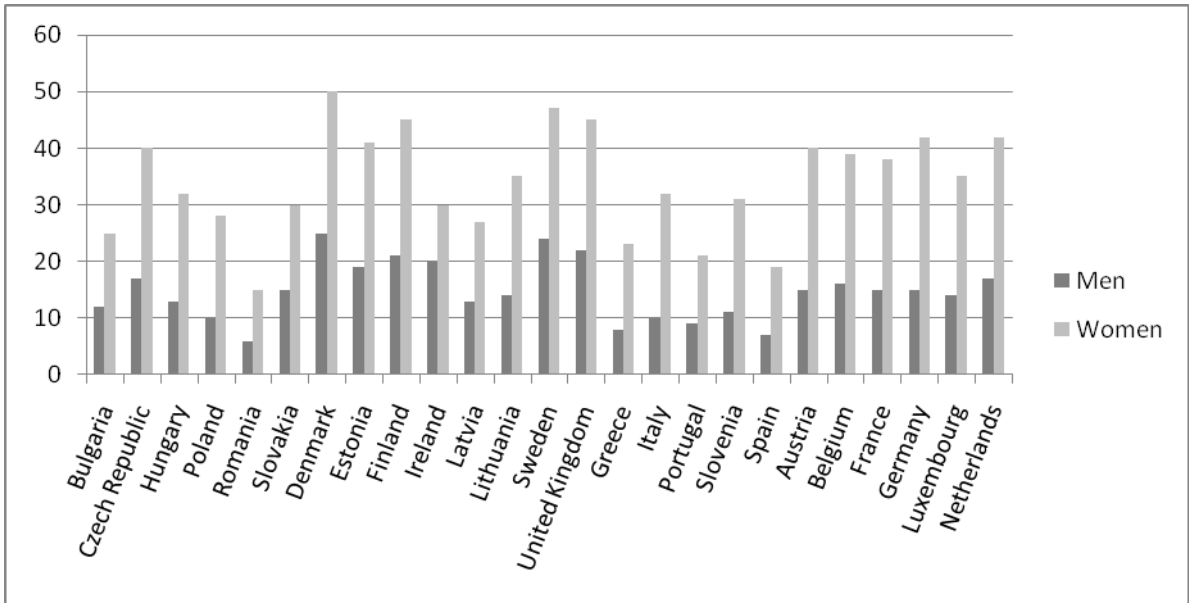

*Source: Authors graph on data from UN 2011*

**Figure 12: Share of men / women currently married among those aged 60 years or over / EU member states**




*Source: Author's graph on data from UN 2011. (Data for Cyprus not available)*

**Figure 13: Number of women living alone in the EU 27.**




*Source: Authors graph on data from UN 2011. Missing Data Malta and Cyprus*

### 3.1.6 HEALTH STATUS OF THE OLDER POPULATION

A critical issue in understanding socio-economic implication of an ageing population is the **heath status** of ageing population.[vii] The consequences associated with the loss of functioning can be far reaching for individuals, families, and communities in terms of both economic costs and quality of life.

The World Health Organizations reports that while at the turn of the 21st century life expectancy in Western European countries ranked among the highest worldwide, the **number of years Europeans can expect to life in poor health remains substantial** (WHO, 2007). However, this is not to say that average health status of older population is decreasing. In recent years, rates of disabilities among older adults have declined significantly in US (see Herd, Robert & House, 2011). Despite this decrease, disability of older population remains substantial. In the US, about 14 million adults aged 65 or older (40%) report a disability, and about 3 million (9%) report more severe limitations in self care activities (Institute of Medicine [IOM] 2007). Estimates of **severe late-life disability** in other developed countries are of similar magnitude or higher, generally ranging from approximately 8%-20% (see Freedman, 2011).

**The data revealed that on average men have higher incidence of fatal diseases and death, but women experience more disability**

It is universally recognized that as individuals age, their health deteriorates. Munnel and colleagues (Munnel et al., 2008) estimate that, although life expectancy for 50 years old men increased by 4.3 years from 1979 to 2000, healthy life expectancy – a measure of **disability-free remaining years**[viii] – increased by somewhat less than 3 years. Illmarinen (2008) reports similar data. On the one hand, life expectancy increased, from 1980 to 2000, by 3 years (2.8 years) for a 65 years old man (woman); however of the **3 years of life expectancy increased**, an average of **1 year is healthy**, and the other **two years are spent chronically ill**. In general a **dramatic increase in chronic diseases** is observed as people age, in particular as they transition from their 60s to their 70s (see later in this section).

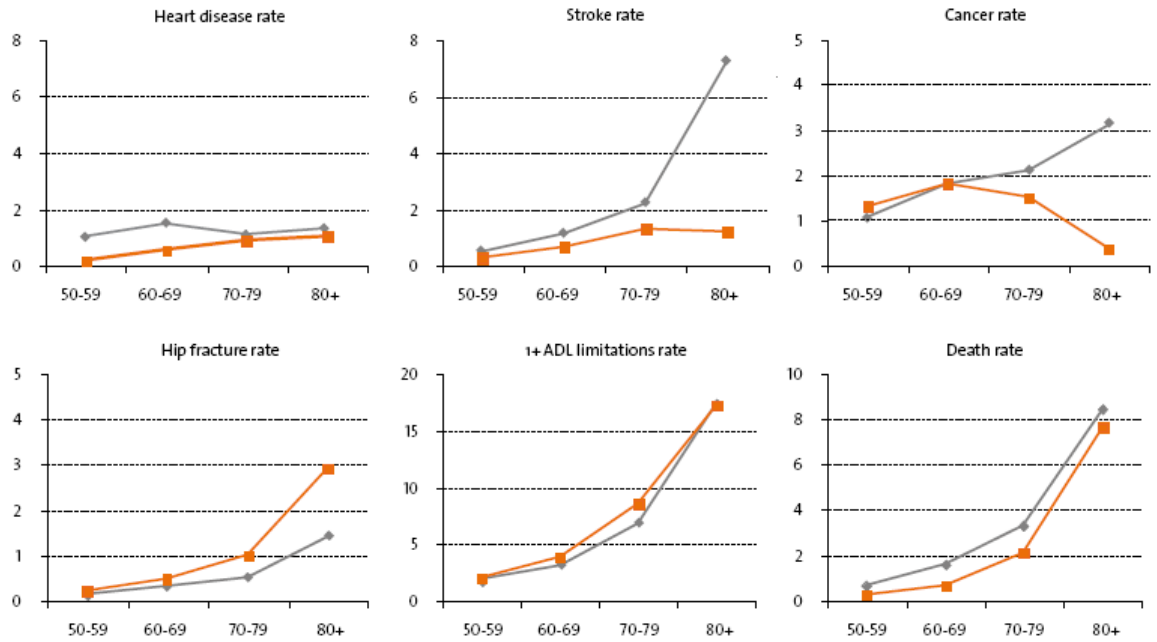
The emerging literature that focuses on analyzing trends in late life disability suggests that increases in life expectancy may be accompanied by increases in active life expectancy (number of years that could be expected to live without limitation).[ix] However, the expected years spent chronically ill has been increasing in the past few decades. Findings by Crimmins and Saito (2001) suggest that such a compression may be concentrated among more educated groups (see later in this section). An analysis by Robine and colleagues (2008) of 14 countries in European Union found a slight increase between 1995 and 2006 in the number of years lived without disability in Europe. However, no consistent pattern was evident across countries.

**Medical advances** such as insulin or antibiotics has led to increased survival of persons with chronic morbidity, which in turn result in an expansion of the proportion of life spent with morbidity or disability, and the concomitant increases in disability prevalence. However, years of life gained are typically achieved through a combination of postponement of disease onset, reduction in severity of disease and disease progression, and improvement of clinical management.[x]

Understanding the magnitude and nature of health deterioration (including gender, geographic and socio-economic differences) is critical for the development of robust prevention and healthcare policies. Two recent studies conducted in Europe (Börsch-Supan & Jürges, 2005; Börsch-Supan et al., 2008) devoted significant effort in surveying and analyzing the health status of the older population.

The data revealed that on average **men have higher incidence of fatal diseases and death, but women experience more disability** (**Figure 14**). The figure also shows the rate of incidence of various diseases as a function of age.[xi]

**Figure 14: Two years of chronic diseases, disability and death per 100 individuals according to age and sex (adjusted for country) in the period 2004- 2006. Grey line: men. Orange line: women. 1+ADL represent a measure of disability**




*Source: SHARE, 2008 (Börsch-Supan et al., 2008)*

Incidence of many chronic diseases increases dramatically with age, but the magnitude of this increase differs for men and women, and across different health outcomes. In particular, incidence of chronic diseases increases considerably after age 70. Incidence of other health related instances show a similar trend. For example, the incidence of hip fractures was found to be only 0.2 per 100 women at ages 50-59, but to be about 15 times higher at ages 80+. Similar events are only weakly correlated with death (i.e. hip fracture per se is only weakly correlated with death), but significantly increase individuals disability.

The studies additionally reported that certain factors, such as **smoking and low physical activity** were most consistently associated with health deterioration among Europeans. Other risk factors, such as **overweight, obesity and alcohol consumption** showed a more mixed picture in terms of impact on different health outcomes.

Authors of the study have suggested that other, non-medical, factors such as favourable socio economic conditions, may mediate the relationship between risk factors and incidence of health outcomes. Indeed, numerous studies have found disparities in health between socioeconomic groups in modern societies (van Doorslaer, Wagstaff et al., 1997; Huisman, Kunst et al., 2004; Dalstra, Kunst et al., 2005). The literature agrees that, on average, older adults with lower income, less wealth, lower health-related quality of life, and lower occupational status, have worse health, greater disability, lower health related quality of life, worse mental health, and earlier mortality than their peer with higher education, income and occupation (Herd et al., 2011).

Studies by Börsch-Supan and colleagues (Börsch-Supan & Jürges, 2005; Börsch-Supan et al., 2008) have also analyzed the correlation between socio economic status and health status. Socioeconomic status is identified by the highest level of education reported[xii] and wealth[xiii]. **Table 6** presents the two-year incidence of chronic diseases, death, poor self-perceive health (defined as deterioration from good/moderate to poor/very poor health), and reports of new limitations with one or more activities of daily living (ADL).

**Europeans with a low educational level or wealth have higher incidence of heart attack and stroke** than their higher educated and

wealthy counterparts. For example, 1.45 percent of Europeans with low wealth reported a stroke compared to 0.85 percent of the wealthiest. In general, it is widely acknowledged that **large differences in healthy life expectancy by educational attainment exist**.

**Table 6: Socio economic status and health outcomes**

| | Education | | | Wealth | | |
|---|---|---|---|---|---|---|
| Heart attack | low | 0.98 | (0.43, 2.27) | low | 0.86 | (0.38,1.97) |
| | middle | 0.68 | (0.27, 1.71) | middle | 0.79 | (0.33, 2.00) |
| | high | 0.48 | (0.17, 1.39) | high | 0.70 | (0.28, 1.79) |
| Stroke | low | 1.42 | (0.64, 3.15) | low | 1.45 | (0.64, 3.28) |
| | middle | 0.94 | (0.38, 2.27) | middle | 1.18 | (0.51, 2.72) |
| | high | 0.85 | (0.31, 2.30) | high | 0.85 | (0.35, 2.07) |
| Cancer | low | 1.70 | (0.97, 3.01) | low | 1.85 | (1.04, 3.32) |
| | middle | 2.03 | (1.15, 3.56) | middle | 2.00 | (1.16, 3.47) |
| | high | 2.31 | (1.31, 4.08) | high | 1.92 | (1.10, 3.35) |
| Poor/very poor health | low | 35.26 | (31.82, 38.86) | low | 35.64 | (32.02, 39.41) |
| | middle | 22.68 | (19.69, 25.95) | middle | 24.80 | (21.85, 27.99) |
| | high | 15.25 | (12.85, 17.98) | high | 21.08 | (18.40, 24.02) |
| 1+ ADL | low | 21.06 | (18.24, 24.17) | low | 20.94 | (18.01, 24.18) |
| | middle | 12.21 | (10.03, 14.76) | middle | 14.86 | (12.53, 17.51) |
| | high | 8.38 | (6.58, 10.60) | high | 11.60 | (9.61, 13.91) |
| Death | low | 5.09 | (3.79, 6.77) | low | 6.09 | (4.55, 8.08) |
| | middle | 3.16 | (2.23, 4.45) | middle | 3.52 | (2.51, 4.90) |
| | high | 2.78 | (1.85, 4.13) | high | 2.52 | (1.76, 3.59) |

*Source: SHARE 2008 (Börsch-Supan et al., 2008)*

Behavioural risk factors associated with socio economic status helps explaining correlations emerging from data analysis. Data from the studies indicate that **lower educated Europeans are generally more likely to smoke, to be physically inactive, and to be overweight**. It is typically hypothesized that education provides a set of psychological and cognitive skills that facilitate better health (Ross, & Wu, 1996).

Subjective social status, how one rates one's social status compared to one's peers, is also associated with multiple health outcomes among older men (for self rated health, depression and long-standing illness) and older women (for self rated health, depression, long standing illness, diabetes, and high density lipoprotein cholesterol) after adjusting for many covariates, including wealth, education, and occupational class (Demakakos et al., 2008) However risk factors do not fully capture disparities among different socio economic groups and health outcomes.

Other key results from the studies on ageing and health are reported here below.

Man have a higher risk of fatal disease and death than women, whereas women are less likely to experience less fatal but more disabling diseases that result in a higher prevalence of disability as compared to men.

Incidence of many chronic diseases increases dramatically with age, bit the magnitude of this increase differs from men and women, and across different health outcomes.

Low socioeconomic status is associated with worsening health.

Europeans with a low educational level and wealth experience more cardiovascular disease, lung disease, arthritis, deterioration in health and disability, and higher mortality rates than their high socioeconomic status counterparts.

Smoking, alcohol consumption, underweight, overweight, obesity, hypertension and diabetes are associated with socioeconomic status, but explain only a small fraction of socioeconomic disparities in health.

There is **ample evidence on the relation between unemployment and ill-health**, showing that unemployment may affect people's health but also that health may determine the selection into and out of the workforce.

**Data from the studies indicate that lower educated Europeans are generally more likely to smoke, to be physically inactive, and to be overweight**

Ill health is a critical risk factor was a risk factor for transitions between paid employment and various forms of non-employment, including retirement, unemployment, and taking care of a household (see later: Pathways to Retirement).

Ill health is an important predictor of withdrawal from paid employment among 50-64 years olds. Ill health increases the likelihood of becoming unemployed or retiring early.

There is a high potential for increasing the labour force participation by health interventions.

If (the effect of) ill health (on withdrawal from the labour market) among 50-64 years olds could be eliminated, the average duration of working life would increase by 13-14 months.

**Table 7** provides statistics on different types of disabilities in Europe and across various countries. **Mechanical disabilities** account for 39.2% of a total of 45.9%. Seeing accounts for 3.5% of the population, while hearing is 1.90%.

**Table 8** indicates that most people with some type of disability in the 55 to 64 age range are **inactive**. Yet there is significant differences across countries, for instance in the UK 53.3% are employed and in Denmark, the European country with higher proportion of working group is at 57.3%.

**Table 9** provides statistics on disabilities across age groups. At the EU level, 92.7% have no disabilities aged 16 to 24. This percentage decreases to 68.6% at age 60-64. Still, the percentage of people with severe or very severe disabilities in this later age range is 17.8%. There is diversity across countries with Romania showing the lowest percentages of disabilities while Finland shows the highest.

**Table 7: Typology of disabilities in Europe**

| | | 55 - 64 years | TYPES OF DISABILITIES | 55 - 64 years | | |
|---|---|---|---|---|---|---|
| Total EU | EU (25 countries) | 7 | problems with arms or hands | 8.3 | Italy | Representative countries |
| | | 14.2 | problems with legs or feet | 14.9 | | |
| | | 18 | problems with back or neck | 16.3 | | |
| | | 3.5 | difficulty in seeing | 2.6 | | |
| | | 1.9 | difficulty in hearing | 1.3 | | |
| | | 0.2 | speech impediment | 0.5 | | |
| | | 1.1 | skin conditions | 1.1 | | |
| | | **45.9** | **TOTAL** | **45** | | |
| Representative countries | France | 8 | problems with arms or hands | 7.4 | Spain | |
| | | 12.9 | problems with legs or feet | 16.7 | | |
| | | 17.2 | problems with back or neck | 23 | | |
| | | 7.1 | difficulty in seeing | 3.4 | | |
| | | 2.8 | difficulty in hearing | 1.2 | | |
| | | : | speech impediment | 0.4 | | |
| | | 1.4 | skin conditions | 0.7 | | |
| | | **49.4** | **TOTAL** | **52.8** | | |
| | United Kingdom | 6.6 | problems with arms or hands | 8.6 | Finland | |
| | | 14.6 | problems with legs or feet | 11.8 | | |
| | | 15.8 | problems with back or neck | 14.1 | | |
| | | 1.9 | difficulty in seeing | 1.2 | | |
| | | 2.2 | difficulty in hearing | 0.9 | | |
| | | : | speech impediment | : | | |
| | | 0.9 | skin conditions | 1.1 | | |
| | | **42** | **TOTAL** | **37.7** | | |

*All values in %, data for Germany unavailable, 2002 data*

**Table 8: Work status of people reported with disabilities**

| | 55 - 64 years | WORK STATUS | 55 - 64 years | |
|---|---|---|---|---|
| EU (25 c.) | 39.6 | employed persons | | |
| | 2.6 | unemployed persons | | |
| | 57.8 | inactive | | |
| Germany | 38.4 | employed persons | 29.2 | Italy |
| | 4.8 | unemployed persons | 1.3 | |
| | 56.8 | inactive | 69.5 | |
| France | 35.9 | employed persons | 39.8 | Spain |
| | 1.9 | unemployed persons | 2.9 | |
| | 62.2 | inactive | 57.3 | |
| UK | 53.3 | employed persons | 57.3 | Denmark |
| | 1.9 | unemployed persons | 2.8 | |
| | 44.8 | inactive | 39.9 | |

*All values in %, 2002 data Source: Eurostat*

**Table 9: Disabilities across age ranges (2002)**

| Age range | | 16 - 24 | 25 - 29 | 30 - 34 | 35 - 39 | 40 - 44 | 45 - 49 | 50 – 54 | 55 - 59 | 60 - 64 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total EU | EU (25 c.) | 92.7 | 91 | 89.6 | 87.7 | 84.9 | 81.8 | 75.8 | 70 | 68.6 | without disability |
| | | 3.1 | 3.6 | 3.9 | 4.2 | 4.9 | 5.5 | 6.8 | 7.3 | 5.4 | lightly disabled |
| | | 1.4 | 1.6 | 1.8 | 2 | 2.2 | 2.7 | 3.1 | 3.3 | 2.9 | with some disability |
| | | 1.3 | 1.8 | 2.4 | 3.2 | 4.1 | 5 | 7.1 | 9.5 | 10.7 | with severe disability |
| | | 0.9 | 1.4 | 1.7 | 2.1 | 2.9 | 3.9 | 5.8 | 8 | 7.1 | very severe disability |
| Main countries | Germany | 96.5 | 95.4 | 94.2 | 92.7 | 90.9 | 88.3 | 83.8 | 77.1 | 75.7 | without disability |
| | | : | : | : | : | : | : | : | : | : | lightly disabled |
| | | 0.5 | 0.5 | 0.9 | 0.8 | 1 | 1.2 | 1.7 | 1.9 | 1.5 | with some disability |
| | | 1.9 | 2.6 | 3.3 | 4.5 | 6.1 | 8.1 | 11.6 | 17.6 | 18.9 | with severe disability |
| | | : | : | : | : | : | : | : | : | : | very severe disability |
| | France | 88.1 | 83.6 | 81.3 | 79.2 | 74.3 | 71.9 | 64.5 | 58.9 | 57.7 | without disability |
| | | 6.5 | 9.4 | 10 | 10.1 | 12.5 | 12.9 | 14.9 | 15.2 | 14.8 | lightly disabled |
| | | 2.6 | 2.8 | 3.7 | 3.9 | 3.8 | 5.2 | 4.9 | 5.3 | 5.1 | with some disability |
| | | 1.6 | 2.4 | 2.9 | 4.3 | 5.2 | 5.2 | 8.6 | 10.6 | 11.8 | with severe disability |
| | | 1.2 | 1.8 | 2.1 | 2.6 | 4.2 | 4.7 | 6.9 | 9.9 | 10.1 | very severe disability |
| | UK | 84.2 | 82.6 | 80.9 | 79.1 | 75.1 | 70.7 | 62.4 | 54 | 46.9 | without disability |
| | | 7 | 7 | 7.5 | 8.1 | 9.1 | 11 | 13.8 | 15.1 | 8.2 | lightly disabled |
| | | 3.1 | 3.1 | 3.4 | 3.5 | 3.9 | 4.1 | 4.3 | 5.3 | 5.3 | with some disability |
| | | 2 | 2.8 | 3.1 | 3.6 | 4.5 | 5.3 | 7 | 8.6 | 5.7 | with severe disability |
| | | 1.9 | 2.6 | 3.6 | 4.3 | 5.6 | 7 | 10.4 | 14.6 | 10.2 | very severe disability |
| | Italy | 97.9 | 97.2 | 96.8 | 95.5 | 94.6 | 92.9 | 89.6 | 86.8 | 83.5 | without disability |
| | | 0.5 | 0.7 | 0.7 | 1.2 | 1.3 | 1.5 | 2.2 | 2.6 | 2.5 | lightly disabled |
| | | 0.4 | 0.5 | 0.5 | 0.8 | 0.8 | 1.2 | 1.4 | 1.3 | 1.5 | with some disability |
| | | 0.4 | 0.5 | 0.7 | 1 | 1.2 | 1.8 | 2.5 | 3.2 | 4.2 | with severe disability |
| | | 0.7 | 1 | 1.1 | 1.3 | 1.9 | 2.5 | 3.8 | 5.4 | 7.5 | very severe disability |
| | Spain | 97.1 | 95.9 | 94.9 | 93.8 | 92.3 | 90.4 | 86.1 | 81.2 | 75.1 | without disability |
| | | 0.9 | 1.1 | 1.1 | 1.3 | 1.6 | 1.7 | 1.6 | 2.5 | 2.5 | lightly disabled |
| | | 0.4 | 0.6 | 0.5 | 0.6 | 0.8 | 0.8 | 1.3 | 1.4 | 1.6 | with some disability |
| | | 0.5 | 0.9 | 1.2 | 1.6 | 2.1 | 2.8 | 3.8 | 5.4 | 7.2 | with severe disability |
| | | 0.9 | 1.3 | 1.9 | 2.4 | 2.6 | 3.7 | 6 | 8.2 | 11.9 | very severe disability |
| Best | Romania | 98.7 | 97.5 | 98.3 | 96.8 | 93.8 | 92 | 88.3 | 86.3 | 85.6 | without disability |
| | | : | 0.3 | 0.1 | 0.7 | 0.7 | 0.8 | 1.5 | 1.2 | 2 | lightly disabled |
| | | : | 0.2 | 0.1 | 0.3 | 0.3 | 0.6 | 0.7 | 1.1 | 0.3 | with some disability |
| | | 0.2 | 0.2 | 0.3 | 0.4 | 1.1 | 1.3 | 2.3 | 1.9 | 2.9 | with severe disability |
| | | 1 | 1.5 | 1.1 | 1.8 | 3.5 | 4.7 | 6.6 | 8.7 | 8 | very severe disability |
| Worst | Finland | 84.2 | 80.4 | 77.8 | 75.3 | 71.6 | 66.3 | 57.2 | 47.7 | 34.1 | without disability |
| | | 7.5 | 8.7 | 9.2 | 10.1 | 11.2 | 13.5 | 14.9 | 15 | 15 | lightly disabled |
| | | 4.9 | 5.1 | 5.4 | 5.3 | 5.3 | 5.5 | 6 | 6.6 | 4.7 | with some disability |
| | | 2.1 | 3.8 | 4.5 | 4.7 | 6.1 | 7.4 | 10.4 | 11.6 | 18.1 | with severe disability |
| | | 1.2 | 1.9 | 3 | 4.3 | 5.5 | 7.3 | 11.4 | 18.9 | 27.7 | very severe disability |

*All values in %. Source: Eurostat*

### 3.1.7 EDUCATIONAL BACKGROUND

**Education** is another important aspect of employability. Lower educational level is associated with higher unemployment. **Table 10** provides definitions of education levels.

**Table 10: Levels of education**

| Years of education | Level of Education | Description |
|---|---|---|
| < 3 years | Level 0 | Pre-primary education |
| 6 years | Level 1 | Primary education or first stage of basic education |
| 12 years | Level 2 | Lower secondary or second stage of basic education |
| 15 - 19 years | Level 3 | (Upper) secondary education |
| 20 - 24 years | Level 4 | Post-secondary non-tertiary education |
| > 25 years | Level 5/6 | First and second stages of tertiary education |

*Source: ISCED 1997*

Education has **important implications** for health but also to remain attractive in the labour market. Lower educational levels are associated with higher risks of ageing with disabilities but also with higher unemployment. The possibility of choosing to be a goldenworker is **built through life** and not only through late life decisions.

**Table 11** shows the level of education in the EU and main countries across various age ranges. The table clearly indicates that educational level is increasing over time. 29.3% of people aged 20 to 24 have a level 5 education compared to 0.36% for people aged more than 40. As population ages, the coming generations will be **better educated**. Illmarinen (2008) reports that the employment rates of older workers depend on the educational level. The **rate increases when the educational level is higher**, the difference between people at the lowest educational level and the highest educational level being almost double among older people.

A high level of education among the 55 – to 64-year age group ensured work for 62,4%, whereas the lowest level of education provided work for only 31,7% of that age group (**Table 12**). Biagi and Lucifora (2008) document an increasing level of education in most countries in Europe, especially in Southern Europe. They relate the level of education (as well as the size of the age cohort and labour institutions) on unemployment. They conclude that "changes in the skill structure ("education boom") reduce the unemployment of the more educated. In other words, we find that education matters: The share of those having more than compulsory education is found to be negatively related to the unemployment rate" (page 1098).

**The possibility of choosing to be a goldenworker is built through life and not only through late life decisions**

**Table 11: Levels of education per age (All values in %)**

| Age range | | 20-24 | 25-29 | 30-34 | 35-39 | >40 | |
|---|---|---|---|---|---|---|---|
| Total EU | EU (27 countries) | 0.09 | 0.11 | 0.1 | 0.08 | 0.05 | L1 |
| | | 0.47 | 0.23 | 0.22 | 0.19 | 0.07 | L2 |
| | | 5.87 | 1.22 | 0.79 | 0.5 | 0.19 | L3 |
| | | 2.47 | 0.44 | 0.23 | 0.08 | 0.02 | L4 |
| | | 29.28 | 9.79 | 4.7 | 2.27 | 0.36 | L5 |
| Main countries | Germany | 0 | 0 | 0 | 0 | : | L1 |
| | | 0.54 | 0.08 | 0.04 | 0 | : | L2 |
| | | 11.98 | 1.49 | 0.03 | 0.01 | : | L3 |
| | | 6.88 | 1.1 | 0.09 | 0 | : | L4 |
| | | 24.3 | 13.83 | 4.19 | 1.38 | : | L5 |
| | France | 0.02 | 0 | 0 | : | : | L1 |
| | | 0 | 0 | 0 | : | : | L2 |
| | | 3.26 | 0.27 | 0.54 | : | : | L3 |
| | | 0.41 | 0.15 | 0.19 | : | : | L4 |
| | | 28.62 | 5.71 | 4.8 | : | : | L5 |
| | UK | 0 | 0 | 0 | 0 | 0 | L1 |
| | | 0.68 | 0.61 | 0.55 | 0.43 | 0.12 | L2 |
| | | 3.35 | 1.49 | 1.03 | 0.84 | 0.24 | L3 |
| | | 0.27 | 0.15 | 0.11 | 0.08 | 0.01 | L4 |
| | | 20.39 | 7.44 | 4.89 | 3.69 | 1.25 | L5 |
| | Italy | 0.19 | 0.2 | 0.14 | 0.09 | 0.02 | L1 |
| | | 0.13 | 0.11 | 0.1 | 0.08 | 0.02 | L2 |
| | | 2.04 | : | : | : | : | L3 |
| | | 0.33 | 0.29 | 0.11 | 0.07 | 0.02 | L4 |
| | | 31.32 | 9.74 | 2.75 | 3.09 | : | L5 |
| | Spain | 0.29 | 0.23 | 0.24 | 0.17 | 0.4 | L1 |
| | | 1.51 | 0.34 | 0.23 | 0.16 | 0.09 | L2 |
| | | 4.84 | 1.22 | 0.62 | 0.62 | 0.13 | L3 |
| | | : | : | : | : | : | L4 |
| | | 28.78 | 9.62 | 3.91 | 2.5 | 0.46 | L5 |

*All values in %, Source: Eurostat*

**Table 12: Employment rates (%) according to age, gender and level of education in the EU 25 countries**

| | EU25 countries | | | |
|---|---|---|---|---|
| | 15–64 years | 15–24 years | 25–54 years | 55–64 years |
| **Men** | 70.7 | 39.4 | 85.2 | 50.2 |
| Elementary | 57.1 | 28.0 | 78.9 | 42.5 |
| Secondary | 74.8 | 52.6 | 85.5 | 50.1 |
| Higher | 86.2 | 61.5 | 91.9 | 66.8 |
| **Women** | 55.7 | 33.1 | 68.9 | 30.9 |
| Elementary | 36.3 | 18.6 | 50.9 | 23.4 |
| Secondary | 62.2 | 45.1 | 71.7 | 36.4 |
| Higher | 79.3 | 60.9 | 84.1 | 55.9 |
| **All** | 63.2 | 36.3 | 77.0 | 40.3 |
| Elementary | 46.4 | 23.6 | 64.6 | 31.7 |
| Secondary | 68.6 | 48.8 | 78.7 | 43.6 |
| Higher | 82.8 | 61.1 | 88.0 | 62.4 |

*Source: Illmarinen (2008)*

### 3.2 Economic Challenges

Awareness is rising that population ageing is posing several challenges in terms of government ability to provide **social security services**, including pensions and healthcare. This is a serious concern in many European countries and in general is considered to **significantly increase the risk of old-age poverty**, which had been successfully tacked with the development of pensions over the twentieth century.

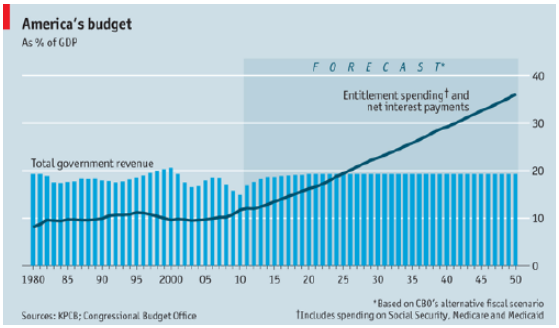
Kohli and Arza (2011) commenting on the evolutionary patterns at the background of pensions reforms in Europe in the past century noted that the full financial impact of generous and universal pension rules as introduces after World War II, started to be observed only some decades later, when the generations under these schemes started to retire. While **pension expenditure** in the 1950s and 1960s where still rather low, by 1980s they had **grown to over 10% of GDP** in Germany and Austria, ad over 8% in Belgium, France, Italy, Sweden and Luxemburg. By 2005, they had passed 5% threshold in all countries but Ireland and Iceland and in some countries, such as Italy, France and Austria, they were already above 12 % of GDP (see also OECD, 2011).

Awareness that pensions' expenditures were likely to represent a challenge for national governments in Europe started to rise after the mid-1970s, when economic growth rates fell. While in some cases pensions schemes continued to expand, in particular as a mean for **facilitating early exit from labour force as a response to economic downturns**, over 1990s expenditure's projections came to be generally regarded as a serious risk for the sustainability of public finances and the competitiveness of national economies.

Among the several challenges that pension schemes now face in Europe, population ageing tops the list. Awareness of population ageing is causing grave concerns among experts about the ability of developed nations to afford the **programs that benefit the retired population**, in particular pensions and health insurance. Life expectancy growth is likely to continue and may even accelerate by mean of biomedical advances. While this certainly represents a great achievement of modern societies it comes at a cost: of working longer, increasing pension contributions or decreasing benefits.

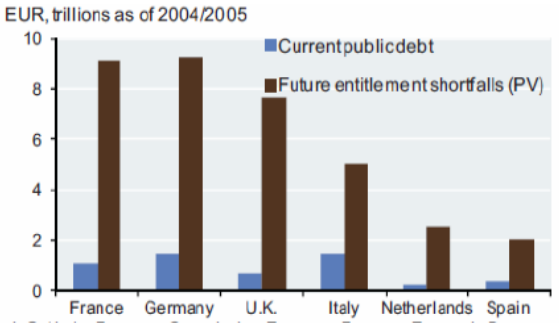
**Figure 15** presents the projected **downfall of government revenues** compared to upcoming liabilities, most of them associated with social security services in the U.S. By 2050, the US government will have a shortfall of around 15% of GDP. This shortfall will hardly be bridged through new debt or rising taxes; therefore the only alternative is to redesign social security.

**Figure 15: Unfunded liabilities in the United States**




The **picture in Europe is as grim** as that in the US. **Figure 16** shows unfunded liabilities for Europe. The economic sustainability of the social security system in Europe as currently designed and given the expected demographic evolution is at risk. Recent increases in retirement ages plus more demanding requirements to access public health services and higher pension schemes are initial reactions to this future. Still, creating jobs and keeping ageing people at work is a central aspect of turning around these forecasts.

**Figure 16: Europe's funding challenges**




Understanding the impact of population ageing on the fiscal sustainability of pension schemes is not trivial, in particular because the former is fully understood only in relationship to dynamics at the macro level, such as the structure of the labour market or the ability of current economies to keep sustaining economic growth.

The most evident impact of population ageing is related to changing structure of the population. Several economists, however, advise that in terms of pension costs and benefits what counts is not crude demography (e.g., dependency ratios) but indeed the **ratio of workers** (as contributors or tax payers) **to pensioners**. In other words, while demographic structure (e.g. population pyramids and similar indicators) may be related to the fiscal sustainability of pension schemes, what really count is the extent to which the **"demographic potential" is really at work** and how much it produces. Changes in employment rates, productivity per worker and age of transition from work to retirement modulate the effect of the underlying demographic structure.

Gist (2011) stresses that population ageing has both direct and indirect as well as near term and long term fiscal implications.

Indirect impacts of ageing are long term, and stem from its effects on the components of macroeconomic growth - the size and composition of the labour force, savings and investments, productivity. Slower growth in the labour force and slower savings rates will cause the economy to grow more slowly, which will cause revenues to grow more slowly. Under normal conditions, economic expansion promotes budget balance because it has the effect of causing revenues to increase more rapidly and causing expenditures sensitive to business cycles to grow more slowly. Faster grow means faster revenue increase. This works in reverse when the economy slows: incomes decline and tax payments decline as well. Economic contractions also increase spending for entitlements programs that are specifically intended to counteract economic cycles, as harder economic times cause more people to qualify for benefits. Higher spending will result in even larger budget deficits and increased government borrowing, with the possibility consequence of making capital scarcer, and put upward pressure on interest rates, adversely impacting the investment necessary for sustained economic growth.

Direct fiscal effect is the surge in outlays for pensions and healthcare services (associated with the necessity to manage chronic diseases for the old population). In the US, spending for Social Security, Medicare and Medicaid is projected to soar from nearly 10% of GDP today to nearly twice that share by 2050, with ageing alone accounting for nearly 30% of overall rising healthcare costs (Gist, 2011).

## Obsolete skills and atypical job increase the risk of unemployment, force early exit, and low wages

The **complexity of tackling the fiscal sustainability of pension schemes** is further increased by macro-economic changes associated with globalization and the rise of market economies that do impact the fiscal sustainability of government spending for pension and social security. According to Kohli and Arza (2011) increase in the mobility of capital (thus the bargaining power of employees), a shift from banks to financial markets as main provider of credit, and a shift from "stakeholders" to shareholders control with claims for more immediate profits jointly are challenging the **political ability of states to levy the taxes** and contributions required for social security (See also Schapf & Schmidt, 2000).

Moreover, flexible labour markets and changing family patterns create new social risks that pose new challenges for pension policy. **Obsolete skills and atypical job increase the risk of unemployment, force early exit, and low wages**. Having to care for children of frail relatives (a non-remunerated work usually performed by women) leads to interrupted labour market participation and part time employment. Kohli and Arza (2011) advise that these new social risks negatively affect, on the one hand,

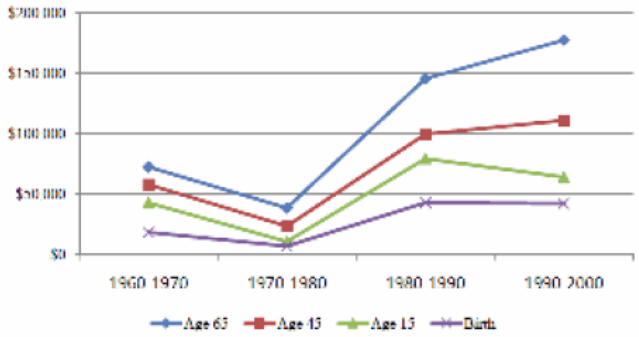
the capacities of workers to build adequate pension entitlements and, on the other hand, governments' incomes.

In most of the European Community (and in the US) the costs of social security programs are projected to rise by mid century to a level that will leave **no room for other government spending** (see Gist, 2011, European Commission, 2006).

Fiscal problems associated with governments project ability for social security spending (including population ageing) have been recently complicated by the economic and financial meltdown that triggered the Great Recession of 2008-2009 (Gist, 2011). First of all the international financial crisis has shattered the belief that the risks of private pensions are fully under control. In OECD countries, **pension funds lost an average of 23% in fund value** (see Kohli and Arza ,2011). The crisis also affected public pensions indirectly, through its impacts on employment and economic growth, two factors that are critical for resources and benefit levels. Further complicating the problem the is the general awareness among experts – in particular economists – that fiscal actions that would normally be appropriate and necessary to address long term problems (particularly deficits) are typically ill advised in a severely weakened economy. These recent challenges are increasing pressures for finding rapid solutions to issues associated with the **fiscal sustainability of social security initiatives**. Kohli and Arza (2011) notes that the reforms already implemented in many countries have **decreased future benefit** levels to a point where adequate income protection for all pensioners will not be given any more.

The economic challenges on the demographic and social security systems now at work are being compounded on the health side by increasing costs. **Figure 17** illustrates increasing healthcare costs mostly for older people

**Figure 17: Healthcare costs per year**




## 3.3 Labour Market Challenges

### 3.3.1 Unemployment

Forecasts indicate that the **demand for high qualification** will increase from 21% in 2000 to 34% by 2020 of the overall working population. In the same period the demand for **low qualification will decrease** from 31% in 2000 to 16% in 2020 (CEDEFOP, 2011). Furthermore, net demand for jobs will exist for legislators, senior officials and managers, professionals, technicians and associate professionals, service, shop and market workers, and elementary occupations; while demand will be zero or negative for clerks, skilled agricultural and fishery workers, crafts and related trades workers, and plant and machine operators and assemblers (CEDEFOP, 2011).

**Table 13** provides the latest statistics on **unemployment** across Europe. The challenge is a **more important issue for younger people** at 19.2% for people aged 20 to 24. In contrast, unemployment is apparently less of a challenge for older people at less than half the rate. Yet, combining this statistic with the participation of older people on the labour force, suggests that this lower unemployment rate is associated with older people choosing not to participate in the labour force.

Unemployment varies dramatically across countries, with Spain having rates of up to 37%. These **dramatic unemployment rates** represent a challenge going forward as this cohort ages with only short spells in the workforce. Job shortages are likely to increase pressure on ageing at work over mid-term horizons.

**Table 13: Unemployment levels across Europe 2010**

| Age range | | 20 - 24 | 25 - 29 | 30 - 34 | 35 - 39 | 40 - 44 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EU | EU (27 c.) | 19.2 | 12.6 | 9.6 | 8.4 | 7.5 | 7.1 | 7 | 7.3 | 6 | 2 | 9.6 |
| Main coun-tries | Germany | 9.5 | 8.4 | 7.4 | 6.8 | 5.7 | 5.9 | 6.4 | 7.7 | 7.8 | : | 7.1 |
| | France | 21.2 | 12.3 | 8.9 | 7.7 | 7.5 | 6.2 | 6.1 | 7 | 5.2 | : | 9.4 |
| | UK | 15 | 8.2 | 6.8 | 5.9 | 5.6 | 5 | 4.9 | 4.9 | 4.4 | 2.8 | 7.8 |
| | Italy | 24.7 | 14.7 | 9.9 | 7.1 | 6.1 | 5.4 | 4.4 | 3.7 | 3.3 | : | 8.4 |
| | Spain | 37 | 25.2 | 19.8 | 18.5 | 17.1 | 15.8 | 14.7 | 15 | 12.5 | 3 | 20.1 |
| Best | Austria | 7.9 | 5.9 | 5.1 | 3.5 | 3.2 | 3 | 3.7 | 2.6 | : | : | 4.4 |

*All values in %, Source: Eurostat*

**Table 14** shows the **dramatic relationship between level of education and unemployment**. At the EU level, rates half as the level of education goes from 0-2 to 3-4 to 5-6. Education is highly correlated with unemployment. Again, unemployment affects those groups at risk with lower education levels.

**Table 14: Unemployment per level of education**

| Age range | | 20 - 24 | 25 - 29 | 30 - 34 | 35 - 39 | 40 - 44 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total EU | EU (27 c.) | 28.4 | 23.7 | 19.6 | 16.5 | 13.6 | 12.3 | 11.1 | 10.6 | 7.7 | L0-2 |
| | | 16.6 | 11.3 | 9.1 | 7.7 | 6.9 | 6.5 | 6.6 | 7.2 | 6.1 | L3-4 |
| | | 16.2 | 9 | 5.6 | 4.6 | 3.8 | 3.4 | 3.4 | 3.7 | 3.8 | L5-6 |
| Main coun tries | Ger. | 16.2 | 23.3 | 20.1 | 17.7 | 14.1 | 13.5 | 13.2 | 13.5 | 13.1 | L0-2 |
| | | 7.2 | 7.4 | 7.3 | 6.7 | 5.9 | 6.1 | 6.8 | 8.5 | 8.2 | L3-4 |
| | | : | 4.1 | 3.1 | 2.7 | 2.3 | 2.6 | 2.7 | 3.9 | 5 | L5-6 |
| | France | 38.1 | 26.3 | 21.1 | 17.2 | 12.9 | 10.8 | 8.6 | 9 | 6.1 | L0-2 |
| | | 19 | 12.2 | 9.3 | 7 | 6.5 | 5 | 5.3 | 6.4 | 6.3 | L3-4 |
| | | 13.6 | 7.7 | 4.9 | 4.1 | 4.8 | 3.2 | 4.1 | 5 | 3.2 | L5-6 |
| | UK | 27 | 17.3 | 16.9 | 12.5 | 10.9 | 8.4 | 8.3 | 6.9 | 3.4 | L0-2 |
| | | 12.7 | 8.9 | 7.6 | 6.5 | 5.3 | 5.1 | 5 | 5 | 5.4 | L3-4 |
| | | 11.7 | 4.8 | 3.5 | 3.1 | 3 | 3 | 2.7 | 3.6 | 3.8 | L5-6 |
| | Italy | 26.5 | 16.9 | 13.7 | 10.2 | 8.6 | 7.8 | 6.8 | 6 | 4.7 | L0-2 |
| | | 24 | 12.4 | 8.2 | 6 | 5.1 | 4.3 | 3.1 | 2.5 | 2.8 | L3-4 |
| | | 23.1 | 18 | 9.1 | 4.5 | 2.7 | 2.2 | 1.4 | : | : | L5-6 |
| | Spain | 44.1 | 33.8 | 29.8 | 26.9 | 24.3 | 22.1 | 20.6 | 19.9 | 15.6 | L0-2 |
| | | 31.7 | 23.5 | 20.7 | 18.9 | 16.9 | 14.1 | 11.2 | 12.4 | 9.3 | L3-4 |
| | | 28.5 | 18 | 11.5 | 10.7 | 8.7 | 7.6 | 6.5 | 5.3 | 6 | L5-6 |
| Best | Austria | 16.6 | 16.1 | 12.2 | 9.1 | 8.2 | 4.8 | 5 | : | : | L0-2 |
| | | 6.4 | 5 | 4.9 | 2.9 | 2.6 | 3.1 | 3.8 | 2.9 | : | L3-4 |
| | | : | : | : | : | : | : | : | : | : | L5-6 |

*All values in %, Source: Eurostat*

Education is associated with the level of employment. Further evidence indicates that **ICT knowledge is correlated with employment** (Peacock, 2009). ICT are becoming even more important not only at work but to find jobs as job markets are migrating to the internet. The digital chasm is again reproduced for people looking for jobs.

The level of education and ICT in particular is an important predictor of losing the current job and being able to find a new one. Education and **lifelong learning** (including ICT skills) appears as an important aspect of ageing at work as well as adapting training needs to the cognitive capabilities of people that have been out of an educational environment for a large number of years.

Peacock (2009) shows how lower ICT skills among aged workers are associated with higher unemployment rates and longer periods of time unemployed.

### 3.3.2 MATURE ENTREPRENEURS

An important aspect of ageing at work is **entrepreneurship**. A relevant alternative to become a goldenworker is to start a business or a social organization. There are numerous examples of people that have started **successful companies** after a corporate career. It is also common for people to use severance packages when they are made redundant in organisations to start a business. Some countries have legislation where pension benefits can be capitalized to become an entrepreneur.

Entrepreneurship requires various ingredients from the ability to identify an opportunity with combining the necessary human and financial resources to running the organisation. Business angels and networks to meet potential partners with complementary skills become important aspects of the process of entrepreneurship.

**Table 15** offers evidence on the **importance of this career path** for goldenworkers. At the EU level, entrepreneurs aged 40 or older are the largest group with 271,952 compared to 167,248 for people in their thirties and 73,653 for people younger than 30. This pattern is consistent across countries highlighting the importance of this path to employment.

**Table 15: Entrepreneurs and age**

| | < 30 years | 30 - 39 years | > 40 years |
|---|---|---|---|
| European Union | 73,653 | 167,248 | 271,952 |
| Romania | 30,151 | 45,163 | 100,098 |
| Portugal | 17,167 | 41,745 | 66,778 |
| Italy | 14,003 | 31,239 | 45,101 |
| Czech Republic | 8,913 | 17,774 | 20,838 |
| Bulgaria | 7,672 | 20,552 | 38,613 |
| Latvia | 3,800 | 8,436 | 9,362 |
| Slovakia | 3,790 | 11,292 | 11,787 |
| Denmark | 2,702 | 8,357 | 9,783 |
| Austria | 2,598 | 17,705 | 20,557 |
| France | 2,241 | 9,738 | 23,150 |
| Sweden | 1,954 | 6,642 | 7,817 |
| Slovenia | 1,662 | 1,613 | 2,401 |
| Lithuania | 1,199 | 6,940 | 11,632 |
| Estonia | 1,166 | 2,737 | 3,087 |
| Luxembourg | 671 | 1,584 | 5,726 |

*Source: Eurostat*

**Table 16** correlates **entrepreneurship and education**. More educated people are more likely to become entrepreneurs (after taking into account the distribution of the population across education levels). This pattern is also quite consistent across countries.

**Table 17** provides further insights on entrepreneurship tabulating the **motivations** to become an entrepreneur. Desire to be her own boss, making money, new challenges, avoid unemployment, and work-life balance are the motives that dominate the decision to become an entrepreneur. These motives are consistent across age groups.

**Table 16: Entrepreneurship and education, 2005**

| | L1-2 | L3 | L4 | L5-6 |
|---|---|---|---|---|
| European Union | 96,913 | 144,341 | 161,771 | 111,477 |
| Bulgaria | 1,266 | 23,327 | 11,507 | 30,059 |
| Czech Republic | 2,641 | 25,764 | 5,970 | 14,916 |
| Denmark | 4,455 | 4,343 | 3,438 | 8,605 |
| Estonia | 157 | 1,084 | 1,488 | 4,260 |
| France | 8,346 | 12,421 | 0 | 14,362 |
| Italy | 30,431 | 44,983 | 1,903 | 13,026 |
| Latvia | 371 | 7,953 | 2,362 | 10,915 |
| Lithuania | 172 | 2,435 | 3,795 | 12,882 |
| Luxembourg | 4,568 | 1,130 | 1,062 | 1,232 |
| Austria | 1,652 | 12,286 | 11,901 | 15,020 |
| Portugal | 62,794 | 29,771 | 7,950 | 24,238 |
| Romania | 44,747 | 11,449 | 117,861 | 2,397 |
| Slovenia | 240 | 2,080 | 1,463 | 1,889 |
| Slovakia | 4,058 | 12,693 | 1,045 | 9,073 |
| Sweden | 2,923 | 5,931 | 3,289 | 4,267 |

*Source: Eurostat*

**Table 17: Motives to become an entrepreneur**

| | < 30 years | 30 - 39 years | > 40 years | Total | |
|---|---|---|---|---|---|
| EU (15 countries) | 202,661 | 260,811 | 226,781 | 690,253 | desire to be own's boss |
| | 189,180 | 243,752 | 237,115 | 670,047 | prospect of making money |
| | 174,012 | 236,001 | 218,751 | 628,764 | desire for new challenges |
| | 133,665 | 161,059 | 162,228 | 456,952 | avoiding unemployment |
| | 104,896 | 147,723 | 148,473 | 401,092 | combining work and private life |
| | 106,109 | 146,816 | 123,798 | 376,723 | getting away from unsatisfactory work situation |
| | 87,609 | 116,333 | 109,648 | 313,590 | realising an idea for a new product or service |
| | 90,870 | 105,975 | 114,595 | 311,440 | desire to make a living from a hobby activity |
| | 77,174 | 97,845 | 92,779 | 267,798 | only possibility to carry out profession |
| | 61,773 | 68,432 | 75,138 | 205,343 | tradition for self-employment in the family |
| | 8,644 | 32,593 | 92,706 | 133,943 | children are big enough |
| | 34,864 | 46,152 | 46,213 | 127,229 | reaching an international market |
| | 16,461 | 18,761 | 21,651 | 56,873 | making a sub-contractor exclusively for former employer |

*Source: Eurostat*

### 3.4 Socio-Cultural Trends

Data on **retirement's prospects** of older population represents an important point of departure for the design of initiatives and policies aimed at tacking issues associated with ageing. At the societal level of analysis, increase in life expectancy, coupled with decreasing fertility rates suggests that perhaps new interventions focused on delaying the age of effective full retirement will be needed in the future to guarantee the viability of social security pension schemes. At the business level the experience of an older workforce represents an important asset – a source of knowledge to be somehow managed and/or retained – transferred.

In the paragraphs that follow we review studies at the nexus between ageing and retirement, starting with general statistics on current trends in ageing and retirement.

#### 3.4.1 Ageing and Retirement—General Data

Several demographic sources indicate that the effective age at retirement varies considerably among populations. According to the United Nations department of Economics and Social Affairs (UN, 2010a) in countries with high per capita incomes, older persons can retire earlier and thus tend to have lower labour force participation rates at older ages. Thus, just **14 % of men aged 65 years or over are economically active in the more developed regions, whereas 35 per cent are in the labour force of the less developed regions**.

The difference is similar among women. In the more developed regions, **8 per cent of older women are economically active, compared to 19 per cent in the less developed regions**. Older persons remain economically active for longer in the less developed regions because of the limited coverage of pension programs and the relatively small incomes they provide. A recent study by the OECD reveals that workers in most OECD countries leave the labour market before the standard pension eligibility age; in some cases, much earlier.

**Figure 18** shows the average effective age of **withdrawal from the labour market**, as well as pensionable, age of labour market exit for men and women. As the figure shows, in most European countries, workers tend to leave the labour market before the age of eligibility for pensions.

**Figure 18: Average effective age of labour-market exit and normal pensionable age**


Note: effective age retirement shown is for five-year period 2004-2009; pensionable age is shown for 2010.

*Source: OECD (2011)*

A substantial literature on the determinants of retirement in the United States (e.g. see Hurd, 1990; Lumsdaine & Mitchell, 1999) suggests that the **increasing generosity of social security**, notably the windfall gains during the 1960s and 1970s, may have played a significant role in the trend among male workers in the post-war period toward early retirement (Costa, 1998; Hurd & Boskin, 1984; Ippolito, 1990). More recent surveys reveal that, in U.S., trends for early retirement are progressively changing in favour of higher participation in the labour force. The **strong trend to early retirement** observed throughout the 1970s and 1980s **came to an end** in the mid 1990s and during the 2000s the proportion of 50-64 years old participating in the labour market has started to creep up (OECD, 2011).

**Just 14 % of men aged 65 years or over are economically active in the more developed regions, whereas 35 per cent are in the labour force of the less developed regions**

Over more than a decade, pre-retirees have been insisting that they expect to work more during the so called "retirement years", both

because they want to **remain active** and because they **need the income or health insurance** that employment provides (see Rix, 2011). Although there is considerable evidence that workers tend to retire earlier than they expected to (Helman et al., 2008), many signs point to prolonged work-lives for a sizeable portion of the labour force. It should be noted that these studies focused on the U.S. population, with limitations in deriving indications for other countries. However, as Rix highlights (2011), trends in labour force participation have been similar in many developed countries, with decreasing participation rates of older men and increased one for women.

Generous pensions and policies designed to expand employment opportunities for younger workers via the retirement of older workers encouraged many people to leave the labour force at **relatively young ages** in countries such as Germany and France. However this trend, at least at the policy level, has changed in past years, as EU has directed attention to older workers retention in light of precarious financed public pension programs in many countries in Europe (Rix, 2005). Towards this end, the European Council established, in 2001, the Stockholm target (i.e. an increase to 50% in the employment rate of persons aged 55 to 64 for 2010) and the Barcelona target, in 2002 (a five years increase in the effective retirement age, or age at which workers leave the labour force). Although these goals were extremely ambitious and with a relative restricted time frame, several sources indicated that considerable progress was made up through 2008 by many countries in **raising the employment rate among the target group** (see Rix, 2011).

For example, six years after the Barcelona target was announced, the rate at which workers leave the labour force has risen by 1.3 years for the EU-27 (see Rix, 2011). As this document is being written, Italian newly appointed government has approved an important reform of the pension system that increase the number of working years from **retirement eligibility from 40 to 42** (41 for women), and introduced negative incentives for those who retire before the age of eligibility for pensions (currently set at 62 years). The choice was motivated, among other reasons, by considering that increase in life expectancy as it has been observed in the past decades, requires population to work longer. It is typically suggested that effective policies should include both **retirement-discouraging "sticks"** (such as the increase in the age of pension eligibility to make retirement less attractive) and **work-enhancing "carrots"** (such as more phased or partial retirement opportunities and reduced social security contributions for workers above a certain age to make work more appealing).

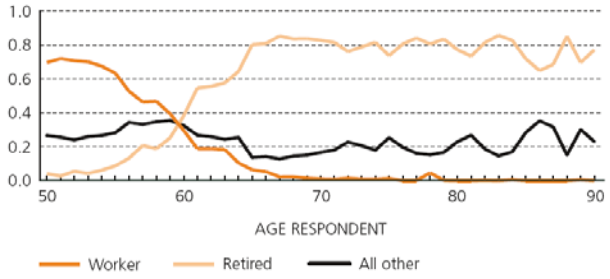
In 2004, a first major study on ageing, health and work was conducted in Europe; the project took the name of SHARE project (Survey of Health, Ageing and Retirement in Europe) and is the first study of Europeans over 50. Funded by the European Union and coordinated by the Mannheim Research Institute for the Economics of Ageing (MEA), SHARE crucial aim was to understand "**ageing and how it affects individuals** in the diverse cultural settings of Europe …" (Börsch-Supan et al., 2005, p. 8). The initial investigation was followed by a second wave, conducted between 2006 and 2008. Similar major studies had been previously conducted in US (i.e., the Health and Retirement Study – HRS ) and in England (i.e., The English Longitudinal study of Ageing). Given that in this review we are primarily interested in the European context (albeit we do recognize the importance of also considering the larger global trends) in the following paragraph with explore with more depth the European context. We seek to do so by integrating findings from SHARE studies with findings from similar studies conducted in US or in OECD countries.

### 3.4.2 AGEING, WORK AND RETIREMENT IN EUROPE

The SHARE study was designed, among other aims, to obtain general indications on the **status of older workers** economic activity in Europe. The study focused on distinguishing between six possible cases: workers, retired, unemployed, disabled, homemaker and "other". Analysis of self reported current economic status of respondents reveals that work and retirement represents the two most prevalent activities in Europe (**Figure 19**).

**Table 18** provides the (weighted) average distribution of all six categories by country and also by country-gender.

**Figure 19: Self reported economic activity by age**




*Source: SHARE 2005 (Börsch-Supan, & Jürges, 2005)*

**Table 18: Self reported labour market status (of Europeans above 50 years) by country (%)**

| | Worker | Retired | Unem-ployed | Disabled | Home-maker | Other |
|---|---|---|---|---|---|---|
| SE | 37,5 | 55,8 | 2,1 | 1,9 | 0,9 | 2 |
| DK | 36,1 | 53,5 | 4,3 | 3,1 | 1,5 | 1,5 |
| DE | 27,8 | 54,4 | 4,9 | 2,4 | 9 | 1,5 |
| NL | 28,4 | 35,5 | 1,9 | 8,3 | 21,1 | 4,9 |
| FR | 25,2 | 56,2 | 3,5 | 2,3 | 11 | 1,9 |
| CH | 38,2 | 46,9 | 1,6 | 3,1 | 8,3 | 1,9 |
| AT | 17 | 66,5 | 2,3 | 1,4 | 11,2 | 1,6 |
| IT | 20 | 55,7 | 1,4 | 0,5 | 21,2 | 1,1 |
| ES | 20,8 | 34,1 | 3,1 | 3,9 | 32,7 | 5,3 |
| GR | 24 | 50,9 | 1,6 | 1,5 | 21 | 1 |

*Source: author's elaboration on SHARE data (Börsch-Supan, & Jürges, 2005)*

In Europe, the prevalence of self reported "working" is in general lower for women than for men. In addition, the distribution of economically active individuals differs across surveyed countries and across age class (**Figure 20**). While in the group of males aged 50-54 more than 80% are economically active with not many differences across countries (only Austria and Spain score below 80%) **significant differences are observed for the groups of those aged 55-59 and 60-64**.

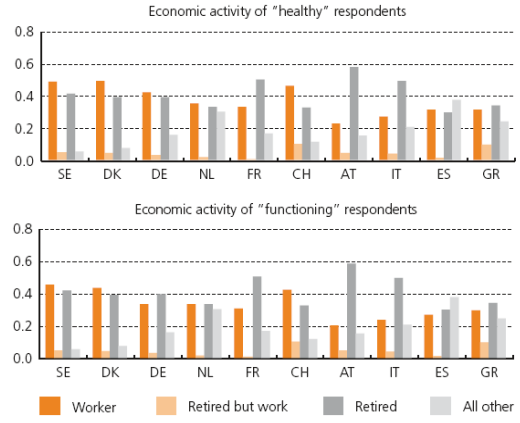
Finally the study goes to reveal the presence of a large "**unused labour capacity**". Even when restricting attention to individuals in good health (**Figure 21**) data reveals that "there is a strikingly high frequency of people with no limitations (or who are 'functioning') that report themselves as fully retired (in particular in France, Austria and Italy).

Good health is defined on the basis of two indicators (i) self-reported absence of limitations in daily activities; (ii) "functioning", i.e., counting zero limitations out of fourteen daily activities.

**Figure 20: Distribution of economically active individuals by gender and by age class**


*Source: SHARE, 2005 – Work and Retirement (Börsch-Supan, & Jürges, 2005)*

**Figure 21: Economic activity and health**




*Source: SHARE, 2005. (Börsch-Supan, & Jürges, 2005)*

In assessing pathways to retirement SHARE has also analyzed, in addition of the **encouragement of early exits** from labour force as embedded in social security and pension schemes, the role played by non standard – but sometimes dominant – forms of transition between employment and full status of retiree. The study has focused on the analysis of three categories of "incentives": unemployment, sickness or disability insurance, and pre-retirement schemes. The general findings reveal that these forms of transitions do play an important role at the national level confirming general findings from similar studies (e.g., see Blondal & Scarpetta, 1998; Gruber & Wise, 2004; Kohli, Rein, Guillemard & Van Gurteren, 1991, OECD, 2003).

A recent study by OECD (2011) has once again confirmed that individuals' decisions to retire are **highly influenced by the financial incentives embedded in the retirement-income system**. While recent pension reforms in most countries have involved policies to reduce the incentive to retire early and increased the incentive to retire after the normal pension age, the former remains high in some OECD countries. In general, the economic literature present overwhelming evidence that **financial incentives embedded in pension systems do affect retirement behaviour**. At the end of 1990s, two studies by OECD (Gruber & Wise, 1998; 1999) compared labour force withdrawal rates between age 60 and 64 with the "implicit tax" from remaining in work exerted by the pension system. They also looked at alternative pathways out of work, such as unemployment and disability benefits. They found an elasticity of labour-force withdrawal with the implicit tax of 0.41. Japan had both the lowest withdrawal rate – with 75% of 60-64 year-olds in work – and the lowest implicit tax on continuing in work. In contrast, Belgium, Italy and the Netherlands had the highest withdrawal rates – with only around 20% of 60-64 year-olds in work – and among the highest implicit taxes on continuing to work at those ages. These general findings were confirmed by later OECD studies (Blöndal % Scarpetta, 1999; Duval, 2003)[xiv].

Another important factor shaping individuals' decision to retire is represented by health status. **Ill health is typically related to the decision to not work**. **Figure 22** shows the associations of ill health with transitions into different states of nonparticipation in the labour market in Europe

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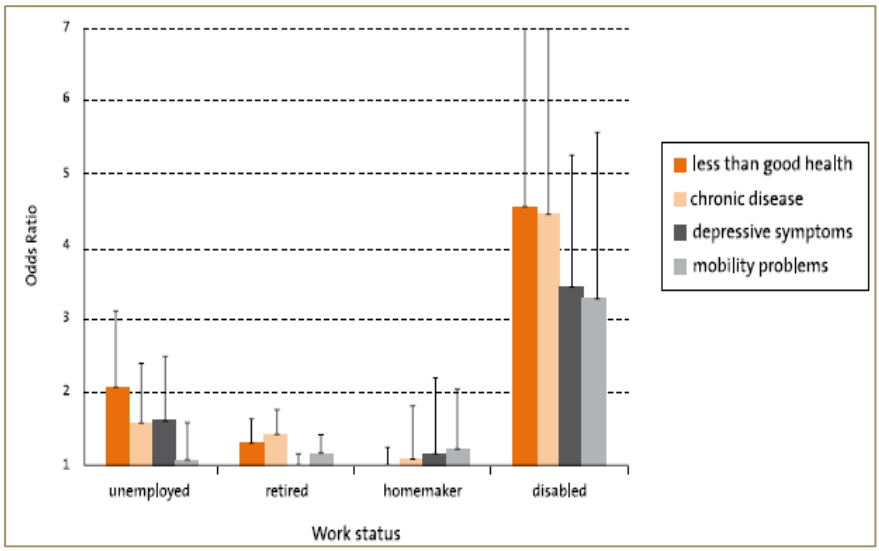
**Figure 22: The effects of different measures of ill health in 2004 on early retirement, unemployment, disability, homemaker, and disability in 2006 in 11 European countries, expressed by adjusted Odds Ratios (ORs)**




*Source: SHARE 2008 (Börsch-Supan et al., 2008)*

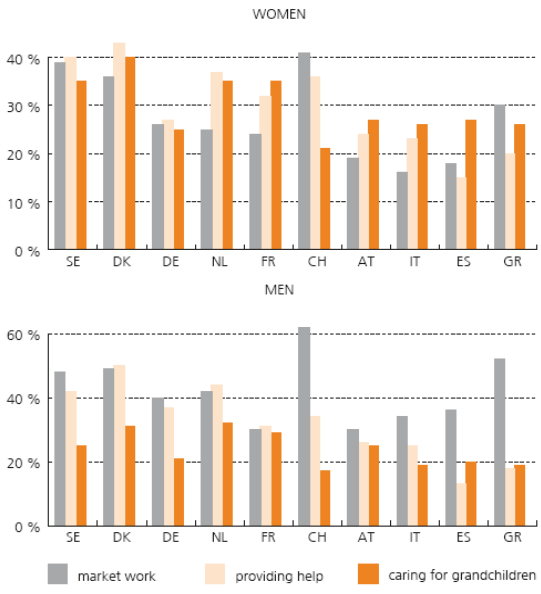
As the figure shows, **ill health is strongly associated with becoming disabled** (ORs from 3.30 to 4.56) **and with becoming unemployed** (ORs from 1.09 to 2.09). The decision to retire is not influenced by depressive symptoms and mobility problems. None of the measures of ill health is associated with becoming a homemaker among women who had had paid employment at the start of the study.

The study also estimated the potential impact of a complete elimination of the effects of ill health on labour market displacement among men with paid employment at the age of 50 years. Results of the analysis revealed that the potential impact of **prevention of ill health** on labour force participation could increase the average age of quitting paid employment from 60.4 to 61.5 years (13.2 months) among men and from 59.2 to 60.5 years (16.2 months) among women.

However, intervention aimed at improving health status of old population is likely to only partially address the issues related to the presence of a large unused labour capacity in Europe. In fact, although those who are employed tend to be healthier on average, there are countries where a **large fraction of retirees are in very good health**. Institutional arrangements do shape pathways to retirement. According to SHARE 2008 (Börsch-Supan et al., 2008), in Europe current institutional setups allow for several pathways to retirement and, at the same time, do not provide incentives to work at older ages. Thus, social security and pension reforms may take some time to exert the desired effects.

In addition, interesting information come from analysis of the way European older adults employ their time. **Figure 23** shows the proportion of elderly engaged in market work, provision of help and looking after grandchildren. Data reveals that in Europe the amount of **time spent helping others** (i.e. providing help or caring for grandchildren) **is significant**. The study goes to suggest that the economic value of these non market activities is significant and of relevant magnitude.

**Figure 23: Prevalence of market and non-market activities by gender and by country**




The first SHARE study was followed by a second one in 2010, also known as 'second wave' (SHARE, 2011); further insights concerning the status of ageing population with

respect to employment in Europe were derived. The second SHARE study came to the following general conclusions/indications[xv]:

- **Individuals in good health retire about two years later** than workers in poor health[xvi].
- Incentives to early retirement induce early exit from the labour market and large "**unused labour capacity**:" Different welfare systems generate different patterns of the distribution and age pattern of labour market participation and retirement. High prevalence of early retirees was observed in those countries that allow early retirement and/or give generous benefits, such as Southern countries, Austria and France.
- **Uptake of disability insurance is unrelated to health status**: The prevalence of the receipt of disability benefits during early retirement ages between 50 and 64 varies dramatically across countries, from 16 percent in Denmark to 3 percent in Greece. Analysts at SHARE additionally concluded that the large variation in disability insurance across Europe cannot be caused by differences in health.
- **Agreeable work place conditions support later retirement**: The quality of employment during the pre-retirement years – for example, how much control we have over our work and how much our efforts are rewarded – varies considerably across Europe, with quality of work being better in the North than in the South.
- **Quality of employment is strongly associated with well-being**: Lower quality of employment goes hand in hand with poor health and depression.

Studies focusing at national level differences (such as SHARE in Europe or HRS in US) emphasize the **importance of exogenous incentives** in catalyzing retirement and overall suggests that "an important determinant of the timing of retirement are the incentives imbedded in the rules determining social security pension benefits, as well as employer-provided pension benefits (see Hurd, 1990; Lumsdaine & Mitchell, 1999 for reviews and Zissimopoulos, Maestas & Karoly 2007; Poterba, Venti & Wise 2004; Anderson, Gustman & Steinmeier, 1999; Samwick, 1998) " SHARE (2008, p.51). Likewise, other studies (Gruber & Wise, 1999; 2004) note that there is a strong negative correlation between labour force participation at older ages and the generosity of early retirement benefits. For this reason, the age of eligibility for public old age-benefits is often taken as a critical indicator of the likelihood of work force willingness to retire.

Recent evidence, however, indicates that labour force participation rates among older men have stabilized and have begun to increase (Quinn, 2002; Karoly & Panis, 2004). Among 55-64 year old American women, labour force participation rates increased substantially between 1950 and the mid 1970s, after which there was a period of stability followed by rapid increases again since 1990. Labour force participation rates of American women 65 and older remained stable throughout this period. Trends among women are harder to interpret, because of the presence of substantial cohort effects. Similar findings emerged from recent studies in Europe (Börsch-Supan, et al., 2008).

**Quality of employment is strongly associated with well-being**

These findings highlighted that while the available evidence suggests a direct relation between "unused labour capacity" and the incentives to retire early embedded in the social security and pension system (Gruber & Wise, 1999, 2004), other determinants play an important role. Prior research has highlighted the importance of both individual level as well as organizational level determinants or individuals decision to retire. Ageing per-se is associated with changes in physical and mental capacities of individuals, as well as motivational level characteristics and other non-ability traits such as personality emotion and affect. The extent to which these changes affect individuals capability to work depends on the match with context specific variables such as job demands, organizational culture, management practices and human resources policies. These aspects highlight the complexity associated with ageing in relationship to work.

Marital status influences the decision to retire. The likelihood of retiring increases if the partner is retired or unemployed. This likelihood is higher for women than men. Health status of the partner also increases the likelihood of retirement, and again the impact is higher for

women with a sick husband (Jimenez-Martin & al, 2000).

### 3.4.3 Cultural Biases

On the side of employers, the demand for older workers may be restricted by **ageist attitudes**, because older workers cost too much or because early retirement provides a convenient way of reducing the size of their workforce. On the side of older workers, their employment opportunities may be limited or unattractive because their **skills have become devalued**, they receive **little help in finding new jobs** or they face **undesirable working conditions** and unsuitable working-time arrangements (OECD, 2011).

According to several authors, **age discrimination represents one of the major barriers to employability of older workers**. Stereotypical ideas and assumptions concerning work attitudes, behaviour and performance of older workers give rise to age discrimination.

Despite this, research reveals that socially constructed perceptions of older workers, including expectation on their behaviour and productivity, are **not supported by empirical investigations**. For example – contrary to general managerial belief - older workers are generally less likely to incur accidents than their younger counterparts, or that there is no evidence of a relationship between age and absence from work.

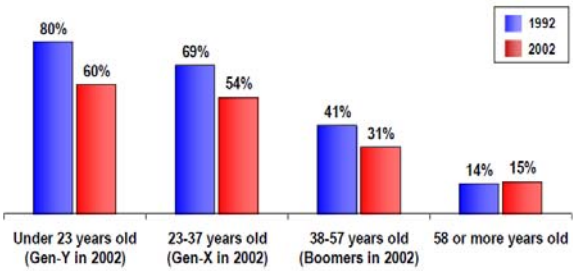
Significant opportunities exist at the level of corporate policy for increasing the work ability of older workers for example by adapting work tasks, work conditions and work arrangements, and promoting a culture that avoids discrimination.

**Age discrimination represents one of the major barriers to employability of older workers**

There are also shifts in **work perception** across generations. For instance, younger generations are less willing to take on **responsibility** (**Figure 24**). The number of people in the 38-57 age range who are happy to take on additional responsibilities has decreased from 41% to 31% in just one decade. This trend towards easier jobs with lower responsibilities is not associated with age but with cultural changes in society.

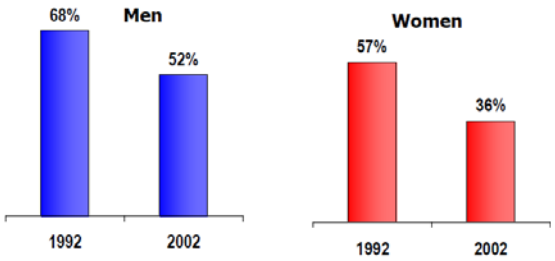
**Figure 25** shows a similar trend over a decade when looking at the data per gender. The trend holds for both women and men.

**Figure 24: Willingness to take on responsibility per age cohorts**




*Source: Generation and Gender in the Workplace, An issue brief by families and work institute*

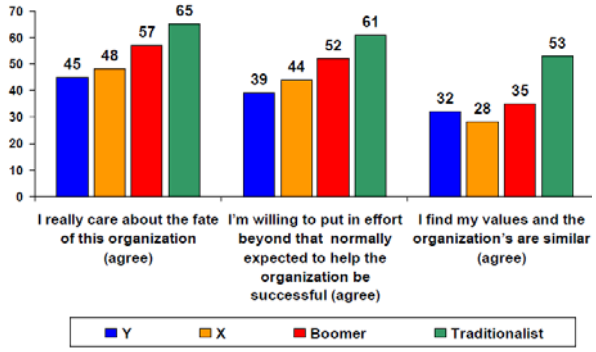
**Figure 25: Willingness to take on responsibility per gender**




*Source: Generation and Gender in the Workplace, An issue brief by families and work institute*

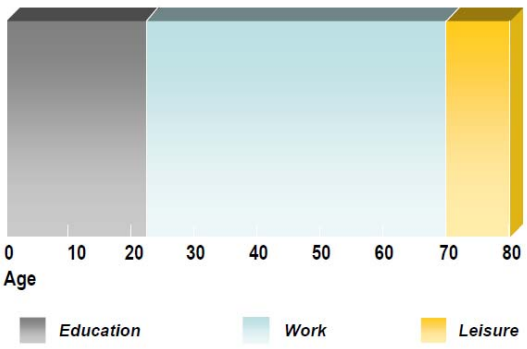
**Figure 26** portrays changes in how people perceive their **relationship with organizations**. The figure shows the trend of increasing mistrust towards organizations and institutions. This trend suggests people choosing to be independent through entrepreneurial initiatives as well as a common finding in ageing at work where older workers are more loyal than younger ones.

**Figure 26: Relationship with organizations**




Another social trend is the **redefinition of life structures**. The traditional life was neatly organized around stages of education, work and retirement (**Figure 27**). A person would start her life with education until she transitioned to the workforce where ideally she remained until reaching retirement. Pension systems are designed with such a life structure in mind. For instance, recent changes in Italian legislation have raised the number of work years to access full pensions. The idea is to discourage early transition into retirement. Similar legislations are being proposed and approved in different member states.

**Figure 27: Traditional life structure**

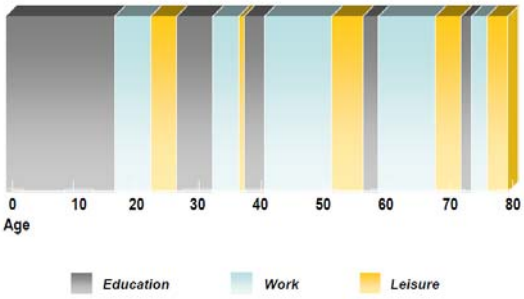



*Source: Demography is De$tiny: The Concours Group and Age Wave. 2003*

However, such a structured and well-defined life structure is being made **obsolete**. More people are mixing the three components of life across time. Under this new structure, there are no sequential stages anymore. The original education stage is followed by a **mix of work, leisure/retirement, and education** (**Figure 28**).

First, knowledge and skills in most fields are evolving fast enough to make whatever was learned in the early educational phase outdated pretty fast. Second, people are asking to have leisure stages earlier in life without having to wait until the old age. It is common in several European countries for people to take a year of abroad travel after the university. The volatility of labour markets also stimulates this mix of stages. People do not have a job for life anymore, but often switch jobs various times in a lifetime. The transitions from one job to another can be used to either introduce leisure or education stages. Finally, education is not a one shot event anymore but a life long learning journey. These periods of education are also in between leisure and work stages. Only at a very late age, leisure/ retirement take over.

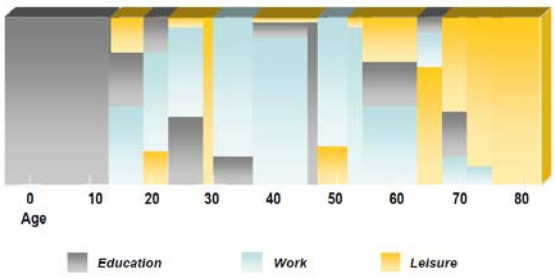
**Figure 28: New life structures**




*Source: Demography is De$tiny: The Concours Group and Age Wave. 2003*

The future of life structure is already a reality for some people. This life structure not only mixes leisure, education and work **sequentially** but also **simultaneously** (**Figure 29**). Part time work and flexibility is gaining in importance as people want to enhance work-life balance. This flexibility is important for young parents as it is for goldenworkers. Similarly, part time education is gaining in importance for people who want to enhance their skills without giving up their jobs. The end product is a much more flexible life structure. New policies such as flexicurity are starting to adapt to these future structures. Technology will also be behind such complex structures to coordinate more flexible life styles.

**Figure 29: Future life structures**




*Source: Demography is De$tiny: The Concours Group and Age Wave. 2003*

### 3.5 Policy Trends

***Europe 2020*** is the European Union's (EU) growth strategy for the coming decade. In a changing world, the EU wants to become a **smart, sustainable and inclusive economy**. These three mutually reinforcing priorities should help the EU and the Member States deliver high levels of employment, productivity and social cohesion.

In particular, the Union has set five ambitious objectives to be reached by 2020: (1) employment, (2) innovation, (3) education, (4) social inclusion and (5) climate/energy.

Each Member State has adopted its own national targets in each of these areas. Concrete actions at EU and national levels underpin the strategy. The full range of EU policies and instruments must be used more effectively to achieve these goals. This includes cross-cutting policies and tools around the ***single market***, the EU ***budget*** (regional development, social and cohesion funds), and ***external policy*** tools.

In line with the first objective, the European Employment Strategy (EES) seeks to create **more and better jobs** throughout the EU. To reach these objectives, the EES encourages measures to meet three headline targets by 2020:

1. 75% of people aged 20-64 in work,
2. school drop-out rates below 10%, and at least 40% of 30-34 year-olds completing third level education,
3. at least 20 million fewer people in or at risk of poverty and social exclusion.
4. The actions are outlined in the flagship initiative "An Agenda for new skills and jobs" structured around the ideas of:
5. equipping people with the right skills,
6. improving quality of jobs and working conditions,
7. flexicurity, and
8. improving job creation.

The EES provides a framework (the "open method of coordination") for EU countries to share information, discuss and coordinate their employment policies. Every year, these national governments (through the Employment Committee) and the European institutions produce the "employment package":

- the **guidelines for national employment policies**, proposed by the Commission and agreed by the national governments, set out common priorities and targets
- the national reports delivered by the national governments and describing their employment policies, which are analysed by the Commission for compliance with the Europe 2020 targets and **flagship initiatives**.
- a **Commission report**, accompanied if appropriate by **recommendations** to national governments.

In parallel to this procedure, there is an *ongoing dialogue* between the Commission, national governments, trade unions, employers' bodies and the other European institutions (European Parliament, European Economic and Social Committee, Committee of Regions, etc.).

**The EU wants to become a smart, sustainable and inclusive economy**

#### 3.5.1 New Skills for New Jobs

The **New Skills for New Jobs** initiative sets out to:

- promote better anticipation of future skills needs,
- develop better matching between skills and labour market needs,
- bridge the gap between the worlds of education and work

Practical measures include:

- Forecasts by the European Centre for the Development of Vocational Training (CEDEFOP)

- Analysis of emerging trends at sector level and the development of sector skills councils
- European Framework for key competences for lifelong learning that defines the eight key competences that everyone should have to thrive in a knowledge society: (1) mother tongue literacy, (2) numeracy, (3) knowledge of foreign languages, (4) science and IT skills, (5) learning to learn, (6) social and civic competence, (7) initiative-taking and entrepreneurship, and (8) cultural awareness and self-expression.
- Ongoing research with the ILO and the OECD
- ESCO - Classification of European Skills/Competences, qualifications and Occupations – currently under development – will describe the most relevant skills, competences and qualifications of occupations
- European Qualifications Framework – which defines qualifications on the basis of learning outcomes so everyone can understand what they mean in practical terms
- EU funding – via the European Social Fund and the Lifelong Learning Programme
- University-Business forum – encourages dialogue between business and education and training providers

### 3.5.2 EMPLOYMENT COMMITTEE

The Employment Committee is a Treaty-based Committee (Art. 150 of the Treaty on the Functioning of the European Union - TFEU) formally created by a Council Decision in January 2000. It plays an important role in the development of the European Employment Strategy.

The **Employment Committee** prepares discussions in the Council each autumn of the employment package: the Employment Guidelines, Joint Employment Report and Recommendations on the implementation of national employment policies. EMCO also formulates Opinions and Contributions at the request of the Council, the Commission or at its own initiative. Opinions and other working documents produced by the Employment Committee are available using the document database on this website. The main outputs of the Committee are:

- Annual 'Employment Package':
- Opinion on the Employment Guidelines
- Joint Employment Report 2011 and previous editions
- Recommendations on the implementation of national employment policies
- Key Messages Paper
- EMCO Opinions and Contributions
- Country Examination (ex-Cambridge Review Reports)
- EMCO Thematic Reports
- Work Programme 2011 and previous Annual work programmes
- Preparation of Council Conclusions
- EMCO Monitoring & Assessment work

Employment Committee documents can also be downloaded from the Council of the European Union's public register.

### 3.5.3 FLEXICURITY

**Flexicurity** is an integrated strategy for enhancing, at the same time, **flexibility and security in the labour market**. It attempts to reconcile employers' need for a flexible workforce with workers' need for security and confidence that they will not face long periods of unemployment. Working with national governments, social partners and academics the European Union has identified a set of common principles around flexicurity (*Council of the European Union, 2008*) and is exploring how countries can implement them through (Communication of the Commission on the common principles of flexicurity, June 2007; Council conclusions on the common principles of flexicurity, November 2007):

- Flexible and reliable contractual arrangements
- Facilitate job search
- Comprehensive lifelong learning strategies
- Effective active labour market policies
- Adapting companies to increase employability
- Modern social security systems

Flexicurity is a crucial element of the Employment Guidelines and the European Employment Strategy as a whole. Integrated flexicurity policies play a key role in modernising labour markets and contributing to the achievement of the 75% employment rate target set by the Europe 2020 Strategy.

Measures taken or initiated in this context include:

- Agenda for new skills and jobs: for reducing segmentation and supporting transitions by strengthening the flexicurity components and implementation; equipping people with the right skills for employment; improving job quality and the working conditions; and supporting job creation
- New skills for new jobs: for upgrading, anticipating and better matching skills and jobs
- Youth on the Move to help young people acquire skills, qualifications and experience
- anticipating, preparing and managing company restructuring
- strengthening public employment services such as job search support, career analyses, validation of experience, etc.

### 3.5.4 European Social Fund (ESF)

The European Social Fund is an instrument for more and better jobs:

- **promotes employment** – mainly by funding initiatives to help people improve their skills and job prospects
- **provides funding across the EU**, in particular in areas with the greatest need as measured by a low GDP compared to the EU average
- **provides** €76 billion in funding over period 2007-13.

The ESF strategy and budget are negotiated and decided on jointly by EU governments, the European Parliament and the Commission. Its seven-year operational programmes are planned by governments and the European Commission. Funding is given to a wide range of organisations – public and private – which provide people with practical help to find a job, or stay in their job.

The ESF will become a major tool for the **smart, sustainable and inclusive growth** of the Europe 2020 strategy. It is a practical demonstration of the balance that future EU employment policies need – actively promoting social inclusion alongside economic growth. The present programming period of the ESF runs until the end of 2013. Preparing for the future of the ESF is part of a long process of consultation and reflection on the best way to achieve the EU's objectives in the frame of the Europe 2020 Strategy.

The Commission has presented its proposals for the EU's next multiannual financial framework in June 2011. In October 2011, it proposed the specific legislative framework for the future ESF. The proposal is part of the Commission's overall legislative package for the Union's future cohesion policy. It will allow the ESF to continue providing concrete support to people who need help to find a job or to progress in their current job.

### 3.5.5 Green Paper on Pensions

The European Commission has put forward proposals to **reform pensions** to ensure that the EU Member States and their citizens can properly fund old age. The "Green Paper - towards adequate, sustainable and safe European pension systems" was put out for consultation in 2010. It addresses a number of interrelated issues including:

- finding ways to ensure adequate incomes in old age while guaranteeing long-term sustainability of pension systems,
- how best to achieve the right balance between work and retirement while making it easier to live an active old age,
- making pensions safer in times of economic crisis; and
- giving pensions systems transparency so that people are better placed to make their own decisions about retirement.

The European Commission is expected to issue its White Paper on Pensions in mid-December 2011.

### 3.5.6 The European Year 2012

The European Year 2012 for **Active Ageing** and **Solidarity between Generations** offers the opportunity to mobilise all actors and resources to find innovative solutions to address the demographic challenge and create an age-friendly environment allowing all citizens to lead more active and independent lives for longer.

AGE has built a comprehensive approach to the concept of active ageing within a growing coalition of stakeholders numbering over 40 organisations and including industry, policy makers at local and regional level and social partners as well as NGOs (***EY2012 Coalition***). The "Manifesto for an Age-Friendly European Union" presents the Decalogue of the **age-friendly society** with a number of recommendations to the EU and stakeholders at

national and local level to achieve an age-friendly European Union by 2020.

**Active Ageing** is defined by the World Health Organization as**:** the process of optimising opportunities for health, participation and security in order to enhance quality of life as *people age*. It allows people to realise their potential for wellbeing throughout their lives and to participate in society according to their needs, desires and capabilities, while providing them with adequate protection, security and care when they need assistance.

It implies **optimising opportunities for physical, social and mental health** to enable older people to take an active part in society without discrimination and to enjoy an independent and good quality of life. On the other hand, creating an intergenerational society needs awareness of each and everyone about what she or he can do for the society of all ages, urgent adaptations of family policies and innovative solutions for new working careers which are life-cycle based.

The objective of EY2012 is to raise awareness in our society to its need to adapt itself to the needs of its ageing population and to tackle *new challenges faced by other age groups* so that all generations continue supporting each other and living together peacefully. This objective has implications regarding policies and practices in regards to town planning, rural development, public transport, access to health care, family policy, education and training, social protection, employment, civic participation, leisure, etc. Demographic change should be looked at as an *opportunity* to bring innovative solutions to many current economic and social challenges.

*Empowering* older people to age in good health and to contribute more actively to the labour market and to their communities will help cope with the demographic challenge in a way that is fair and sustainable for all generations. Involving young people at early stages is necessary to get mutual inspiration and to raise awareness of the interdependence of the generations, e.g. in terms of pension systems.

The European Year is designed to serve as a framework for:

- **raising awareness** on the contribution that older people make to society and the important part that young people play for a holistic society,
- identifying and disseminating **good practice**,
- **mobilising policymakers** and relevant stakeholders at all levels to promote active ageing,
- calling for **greater cooperation** and solidarity between generations.

A wide range of stakeholders: national, regional and local authorities, employers and trade unions, the business sector, civil society organisations, researchers, etc. should use this opportunity to propose action to support active ageing in the field of: employment, social protection, family policies, education and training, health and social services, as well as housing, transport, leisure, and public infrastructures.

### 3.5.7 THE EUROPEAN INNOVATION PARTNERSHIP

European Innovation Partnerships are a new way of *bringing together* ***public and private actors*** at EU, national and regional level to tackle the big challenges such as climate change, energy and food security, health and an ageing population. These challenges also represent opportunities for new business and the Partnerships will aim to give the EU a first-mover advantage in these markets.

The EU is committed to promoting the concept of active ageing, which is about ensuring that older people can play an active role in society and, a pilot *European Innovation Partnership on Active and Healthy Ageing* was launched earlier this year with the objectives of:

1. enabling EU citizens to lead **healthy, active and independent lives** while ageing,
2. improving the **sustainability and efficiency of social and health care systems**,
3. boosting and improving the **competitiveness of the markets for innovative products and services**, responding to the ageing challenge at both EU and global level, thus creating new opportunities for businesses.

This will be realised in the three areas of prevention and health promotion, care and cure, and active and independent living of elderly people. The overarching target of this pilot partnership will be to increase the average healthy lifespan by two years by 2020.

The pilot Partnership aims at achieving these goals through bringing together key stakeholders (end users, public authorities, industry); all actors in the innovation cycle, from

research to adoption (adaptation), along with those engaged in standardisation and regulation. The pilot partnership provides these actors with a forum in which they can cooperate, united around a common vision that values older people and their contribution to society, and identify and overcome potential innovations barriers. It works through improving the framework conditions for uptake of innovation, leveraging financing and investments in innovation and improve coordination and coherence between funding for research and innovation at European, national and regional level in Europe.

This altogether will foster **innovation** in products, processes and services, and in parallel facilitate the innovation chain and reduce the time to market for innovative solutions. Ultimately this will produce benefits for innovation's final users – the older people and care providers.

The high level Steering Group, set up by the European Commission to assist with launch and implementation of the pilot partnership, adopted the ***Strategic Implementation Plan*** (SIP) in 7 November 2011. The SIP outlines a common vision and a set of operational priority actions to address the **challenge of ageing through innovation**. The next steps will be for the European Commission and stakeholders (Member States, regions, industry, health and social care professionals, elderly and patient organisations) to work together on making this plan a reality. In addition, networking and knowledge sharing on innovation for age-friendly buildings, cities and environments will be pursued. The Strategic Implementation Plan foresees a first set of specific actions to be launched in 2012:

- innovative ways to ensure patients follow their prescriptions – a concerted action in at least 30 European regions,
- innovative solutions to prevent falls and support early diagnosis for older people,
- co-operation to help prevent functional decline and frailty, with a particular focus on malnutrition,
- spread and promote successful innovative integrated care models for chronic diseases amongst older patients, such as through remote monitoring. Action should be taken in a number of the EU's regions,
- improve the uptake of interoperable ICT independent living solutions through global standards to help older people stay independent, mobile and active for longer.

The Strategic Implementation Plan (SIP) is the first result of about six months of intense work by a wide group of stakeholders that for the first time came together to develop a European Innovation Partnership on active and healthy ageing. The SIP is a stakeholders' rather than a Commission plan.

The SIP is a strategic framework for action agreed by a wide community. At this stage it does not present details of resources and action-holders. Rather, it presents:

- a strategy based on a positive vision on ageing around three areas: prevention & early diagnosis, care & cure, active ageing & independent living,
- a focus on five specific actions to start in 2012. These actions should show how to tackle innovation barriers. Other future actions can follow their path,
- an outline of implementation. The detailed implementation of each action will be provided by the committed actors themselves, based on their own contributions, further advocacy towards and involvement of Member States authorities (e.g. health ministries), and the forthcoming EC contribution (expected for early 2012).

In addition, supporting actions include the recruitment of reference sites that would trial all or most of the 6 actions, common monitoring and evidence building, and developing networks and a knowledge base on age-friendly innovation.

The next steps are:

- presentation in Council,
- communication on this EIP and its Strategic Implementation Plan by the EC early 2012,
- continued awareness raising and advocacy,
- calls for commitment early 2012 which will be organised by the EC services,
- establishment of action groups of committed parties to implement actions,
- discussion in Council and EP in first half 2012,
- conference of EIP partners, mid 2012.

**Knowledge Innovation Communities** (KICs) have been established by the European Institute of Innovation and Technology. The

Institute's mission is to increase European sustainable growth and competitiveness by reinforcing the innovation capacity of the EU.

A KIC is a highly integrated, creative and excellence-driven partnership which brings together the fields of education, technology, research, business and entrepreneurship, in order to produce new innovations and new innovation models that inspire others to emulate it. They are to become key drivers of sustainable economic growth and competitiveness across Europe through world-leading innovation.

The Commission plans to set up the new KICs in two phases.

The first group, to be set up in 2014, will have the following themes: innovation for healthy living and active ageing (improving the quality of life and well-being of citizens of all ages); food4future (sustainable food supply chain, from farm to fork); raw materials (sustainable exploration, extraction, processing, recycling and substitution of raw materials).

The next wave of KICs, to be established in 2018, will focus on: added value manufacturing (developing more competitive, sustainable and environmentally-friendly manufacturing processes); smart secure societies (addressing Europe's security gaps through the development and deployment of innovative ICT solutions); and urban mobility (delivering a greener, more inclusive, safer and smarter urban mobility system).

The **themes** were selected on the basis of criteria established by the Commission, following a public consultation with the innovation community.

### 3.5.8 European Commission Work Programme 2012 on Employment

The EC foresees to issue, during 2012, as part of its Employment Package, Communications on:

(1) **Towards a jobs-rich recovery**: Umbrella communication of the Employment package setting out the Commission contribution to a growth- and job-rich economy, building on the flagship initiatives adopted as part of Europe 2020 (and in particular "An agenda for new skills and jobs" and "Youth on the Move") and linking in with the orientations of the 2012 Annual Growth Survey.

(2) **Specific Flexicurity package**: The Communication will highlight the key role of flexicurity policies in the current economic climate. It will set out concrete proposals to strengthen the different components of flexicurity to address the economic challenges that Europe is facing, with a view to reducing labour market segmentation and supporting labour market transitions.

(3) **Reforming the European Employment Services EURES and its legal basis**: The proposal will aim to: 1) improve access to employment opportunities and facilitate job creation by establishing EURES as matching placement and recruitment tool for labour mobility across Europe; 2) expand EURES to support the new "Your First EURES Job" scheme; 3) reflect the ECJ jurisprudence on placement services which will need to be opened up to private employment services while widening the range of EURES partners. This may involve revision of Regulation 1612/1968.

The Communication will build on the current strategy and build on the final evaluation of the current strategy, in particular in terms of a) enhancing occupational health and safety (OSH) governance at EU level, in particular as regards the establishment of national OSH strategies and the coordination of Member States' policies b) improving implementation of the EU legal framework c) promoting health and safety at the workplace, by supporting the Member States' efforts through European campaigns and awareness raising initiatives.

It plans a legislative initiative on protection of supplementary pension rights of people who change jobs.

The aim is to conclude the negotiations on the 2005 Commission proposal modified in 2007. In particular, the proposal would aim to address the issue of vesting periods (duration of employment before pension rights are irrevocably granted).

The conclusions of European ministers responsible for employment and social policy indicate that to **reach 75% employment rates as part of EU's 2020 objectives**, radical structural reforms and deep-reaching modifications to social policies should be sought to create the 17.6 million new jobs need. The Employment Committee report "Reaching the employment target: progress and thematic surveillance" has led to outline these radical reforms that are expected to target people on the labour market whose prospects are deemed "sombre", namely under-qualified workers, women and elderly workers, in an effort to stimulate their recruitment. The second target involves young people with an unemployment stands of 21% across the EU. Better adaptation and improved quality of education systems and

training are the main levers to increase their employment rates.

AGE developed "**how can the European Union lessen the impact of recession on older workers: an assessment and recommendations**" (2009). It is currently developing a further policy position paper on the employment of older workers as a contribution to the EY2012. The paper will bring together various aspects of employment which concern older workers (campaign for career's leave directive, holistic approach to age management in the workplace, mandatory retirement age, flexibility, ergonomics, work-life balance, phased retirement, gender dimension, …). It will include examples of good practice and recent developments as well as include instances of bad practice that we want to raise.

**To reach 75% employment rates as part of EU's 2020 objectives, radical structural reforms should be sought**

## 3.6 Comparative of National Policies EU on Ageing at Work

### 3.6.1 A Wide Range of Policies

The OECD, in its report Live Longer, Work Longer 2006, shows how ageing is already pressuring public finances and how it will reduce growth in living standards. As OECD suggests, these consequences of ageing could be balanced by **policies** to promote greater immigration, higher fertility or faster productivity growth, but also through public **policies to improve the employment prospects of older workers**.

For Goldenworkers purposes, we have gone through this **last typology** of policies and we have review from available reports on that field what has been done so far by EU Governments at European, national and some examples at regional level.

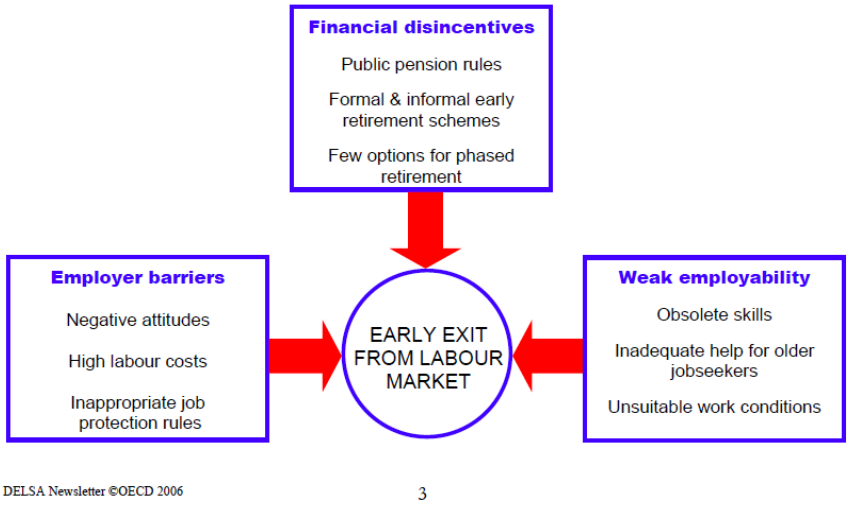
Before going through this review of policies, is important to outline that there is still **room for promoting employment of older workers**, although the situation varies across countries. Some data on that from OECD's report[xvii]: In 2004, less than 60% of the population aged 50-64 had a job, on average in the OECD, compared with 76% for the age group 24-49. The figure varies from less than 50% in certain countries to more than 70% in others.

As several reports highlight, there are many work disincentives or barriers facing older workers, which usually provokes an early exit from labour market. In average, the number of years that workers expect to spend in retirement has risen: for men, from less than 11 years on average across the OECD in 1970 to just under 18 years in 2004 and, for women, from less than 14 years to just under 23 years.

### 3.6.2 What these Policies have in Common

The policies to improve the employment prospects of older worker, mainly address the **financial incentives** (from supply and demand side) embedded in pension systems and other welfare benefits, which play an important role in work-retirement decisions. In that sense, it appears essential that older people do not face a large implicit tax if they chose to continue to work (**Figure 30**). In other words, countries have carried different policies and reforms to make retirement, at least at very early ages, more difficult or less attractive; to make working longer more appealing; and, in some cases, to make older workers more attractive to employers.

**Figure 30: Framework for factors for early exit from labour market, addressed by policies**




Almost all review countries have been carrying out reforms to tackle work disincentives and increase flexibility in work-retirement decisions.

A number of **common elements** to this kind of policies or reforms include:

- Reductions of pension replacement rates
- Increasing the official and earliest ages of retirement
- Introducing or changing actuarial adjustments in pension benefits for early and late retirement.
- More flexibility in combining work and pensions and introduction of partial retirement programs
- Reducing social security contributions for workers over a certain age
- Increasing pension accrual rates or bonuses for working beyond retirement age
- Reducing social security contributions for workers over a certain age
- Tightening the eligibility criteria for early retirement;
- Increasing the years of contributions required to qualify for pension benefits
- Indexing pension receipt to life expectancy;
- Tightening eligibility criteria for disability pensions

But there are different approaches. For instance, there are some countries that are in favor of a **neutral framework**, which enable to claim a pension at a relatively young age (but with the appropriate downward benefit adjustment) and to reward later retirement through an upward benefit adjustment. Other countries prefer to reduce the possibilities for taking up a pension before the official retirement age, even with a reduced benefit. This means bringing the minimum retirement age as close as possible to the official retirement age – on the grounds that individuals need to be guided in their choice. There are also important differences with respect to the treatment of workers who have been in arduous jobs or who started work at a young age.

### 3.6.3 The Importance of an Holistic Approach: Tackling the Reforms and Policies Together

As some policy reports shows in that issue, reforms to the pension system have to be done together with unemployment, disability and other welfare benefits, so that they are not used as alternative pathways to early exit from the labour market.

These benefits should not facilitate early retirement for those still able to work.

This is a difficult task for regulators. As early retirement will increasingly become more difficult or less feasible, there will be a growing pressure to use these pathways instead.

### 3.6.4 Overview of EU National Policies in the Different Typologies

We provide below three summary tables that provides an overview of national policies to tackle the demographic pressure on the pension system, which includes: reduction of pension generosity for workers retiring; increasing rewards and penalties associated with timing of retirement; and restricting options for early retirement.

1. **Reduction of pension generosity** for workers retiring at a given age with a given contribution history (**Table 19**).

**Table 19: Retirement age policies**

| Country | Reform | Affecting whom | When |
|---|---|---|---|
| *(i) By raising the official pension age* | | | |
| Australia | Official age: From 60 to 65 | Women | 1995-2014 |
| | Earliest age: From 55 to 60 (for mandatory occupational pensions) | All | 2015-2025 |
| Austria | Official age: From 60 to 65 | Women | 2023-2033 |
| | Earliest age: From 60 to 62 | Men | 2000-2005 |
| | Earliest age: From 55 to 62 | Women | 2000-2027 |
| Belgium | Official age: From 60 to 65 | Women in private sector | 1997-2009 |
| Czech Republic | Official age: From 60 to 63 | Men | 1996-2012 |
| | Official age: From 53-57 to 59-63 | Women | 1996-2012 |
| Denmark | Official age: *Reduced* from 67 to 65, but in combination with other measures shown below | All | 2004 |
| Germany | Earliest age: *Reduced* from 63 to 62 | Men | By 2010 |
| | Earliest age: From 60 to 62 | Women | 2011-2016 |
| Italy | Official age: From 60 to 65 | Men | From 1992 |
| | Official age: From 55 to 60 | Women | From 1992 |
| Japan | Official age: From 60 to 65 for flat-rate pension | Men | 2001-2013 |
| | Official age: From 60 to 65 for flat-rate pension | Women | 2006-2018 |
| | Official age: From 60 to 65 for earnings-related pension | Men | 2013-2025 |
| | Official age: From 60 to 65 for earnings-related pension | Women | 2018-2030 |
| Korea | Official age: From 60 to 65 | All | 2013-2033 |
| | Earliest age: From 55 to 60 | All | 2013-2033 |
| Switzerland | Official age: From 62 to 64 | Women | 2000-2005 |
| United Kingdom | Official age: From 60 to 65 | Women | 2010-2020 |
| | Earliest age: From 60 to 65 (Pension Credit) | Men | 2010-2020 |
| United States | Official age: From 65 to 67 for full eligibility | All | 2000-2027 |

*Source: OECD*

2. Increasing **rewards and penalties** associated with timing of retirement (**Table 20**).
3. **Restricting options** for early retirement (**Table 21**)
4. **Flexible pathways to retirement**

Two EU experiences to be highlighted: Sweden and Finland.

"In Finland, the **part-time pension** is an increasingly successful way of smoothing translation from work to retirement. In 2001, 6% of persons aged 56 to 64 were in receipt of the part-time pension. It entitles workers aged 56 and over to 50% of the income loss due to a reduction in working time, paid through the pension system. Part-time workers of this age also get full accrual of future pension rights. Surveys show that most people receiving this payment subsequently move into full retirement, showing that it does help encourage older workers to exit the workforce gradually. However it is not clear that this encouragement actually increases rather tan reduces labour supply" (source: OECD)

**Table 20: Rewards and penalties for retirement**

| Country | Reform | Affecting whom | When |
|---|---|---|---|
| Australia | Lump-sum bonus for deferral up to five years | All | 1998 |
| Austria | Increase penalty for early retirement from 2% to 4.2% p.a. | All | 1997 |
| Belgium | Higher pension for deferring after 60 in public sector, up to 9% by age 65 | All | 2001 |
| Denmark | Pension reduction around 10% for retiring age 60-62 | All | 1999 |
| | Lump-sum bonus for working between 62 and 65 | All | |
| | Higher pensions for deferring after age 65 (*e.g.* +7% if defer to 66) | All | 1999 |
| | | | 2004 |
| Finland | Flexible retirement age from 62 to 68 (7.2% bonus for delaying retirement to age 63 and 4.5% thereafter to age 68) | All | 2005 |
| France | A bonus of 3% for each year the pension is postponed beyond age 60 (for those already at the full rate) | All | 2004 |
| | Workers can draw a fraction of the pension while continuing to work under the scheme of progressive retirement | All | 2005 |
| Germany | Pension 3.6% lower if retire aged 63-64; 6% higher for each year post-65 | All | 1997-2004 |
| Italy | Actuarially equivalent reductions from age 57 | All | 2015-2033[a] |
| Spain | Higher pension for retiring after 65: 2% for each year with no limit (for individuals with 35 years of contributions) | All | 2002 |
| Sweden | Flexible retirement from age 61 with actuarially-based rewards/penalties for individuals with 35 years of Social Insurance contributions | All | 1999 |
| United Kingdom | Higher pension for retiring between 65 and 70: raised from 7.5% to 10.4% for each year, with lump-sum option added | All | 2005 |

**Table 21: Restriction retirement options**

| Country | Reform | Affecting whom | When |
|---|---|---|---|
| Austria | From 60 to 61.5 | Men | 2000-2002 |
| | From 55 to 56.5 | Women | 2000-2002 |
| | From 56.5 to 61.5 | Women | 2018-2034 |
| Belgium | Require 35 rather than 30 years contributions to retire early at 60. | All | 1997-2005 |
| Italy | Seniority pensions for employees available from age 57 or with 40 years of contribution (previously from age 54-56 or with 37 years of contributions). | All | 2002-2008 |

a) For a full work career starting at age 20 and assuming retirement at age 57.
*Source:* OECD series on *Ageing and Employment Policies*.

"In Sweden, concerns about such negative effects have caused the replacement in 2001 of a subsidised partial pension in favour of more neutral conditions enabling people part-time who wish to work part-time to do so without unduly subsidising them. Sweden has questioned the appropriateness of very generous rewards for working part-time that may at best be having a largely deadweight effect and at worst be reducing the number of hours worked overall. Under Sweden's new pension arrangements, a **generous partial pension is available in the state sector only**. However, in addition, under reformed arrangements for pensions available to all workers, workers are permitted to draw a portion of their pension early while still working. In this case, however, there is not a special state subsidy to encourage individuals to take

up this option. ON the contrary, workers will themselves have to balance the value of working part-time with a top-up that may make this affordable, against the future impact n their pension in full retirement caused by taking part of the pension early with an actuarial reduction. In other words, a balanced economic decision is put in the hands of individuals rather tan the government actively promoting a particular option" (source: OECD).

### 3.6.5 Some EU Regional Policies

As the EPRC shows in its report Dealing with Demographic Change: Regional Policy Responses (2010), there is also growing recognition that the regional level provides and appropriate arena for policy responses to demographic change. Although much of the policies that should apply for this challenge usually would be placed at national level (because in most cases the main competences applying to this issue are placed at national government) is true that there is an increasing role of regions in Europe which are launching different strategies, plans and initiatives that promotes active ageing in different realities, including at work. The reason to justify this prominent role, as EPRC shows in its report, is that regional governments are usually more close to the **complex interaction of factors** that dictate different patterns of demographic change to develop suitable policy responses. As the report highlights, many regional-level authorities have an increasing autonomy and economic resources to develop strategies or other initiatives that address this challenge by cutting across multiple policy domains.

Although this report is not especially devoted to this issue, we wanted to share in brief some examples that are taken from EPRC report (2010):

**Northern Ireland**: these issues have been taken into consideration in the principle of Targeting social Need (TSN), which is a high level policy for increasing employability, and addressing the causes of social exclusion. Policy actions are focused on the areas of greatest deprivation and highlight particularly the problems of older people, including older workers in poorly paid jobs, pensioners with no income other than state retirement pension and state benefits, and older people living in unfit homes.

**In Austria, the Land of Burgenland** has developed a specific security and care facilities, but also the integration of the elderly into society. The proposal actions include the set up of day centres, promotion of education and the facilitation of elderly access to new media, all of which promote their inclusion in society and encourage further cross-generational contacts.

In the **Netherlands**, concerns regarding population decline in some areas have prompted the drafting of an Action Plan, which is currently being developed for consideration by the Dutch cabinet.

In other cases, processes of regionalization have produced a range of strategies or programmes, concerning economic or spatial development, transport or the labour market onto which the demographic agenda can be mapped or mainstreamed.

Evaluating policies requires adequate methods to validate the effectiveness of the policies and clear objectives to anchor these evaluations, as well as having policy making be guided by hard evidence and not only by ideological criteria (Grubb and Ryan, 1999)

## 4. INFORMATION AND COMMUNICATION TECHNOLOGIES

- **Older workers and less educated people face larger challenges to adapt to ICT tools: The digital divide.**
- **ICT innovations can help goldenworkers to feel well and stay longer at work or even change working profile.**
- **Personalized, adaptive, and embedded applications can facilitate ICT integration for goldenworkers.**
- **ICT for elderly has looked at all aspects of living. Various classifications of technology functions have been proposed: enabling, operational, connective, and telemedicine; ubiquitous communication, ubiquitous computing, intelligent user interface, and adaptive software; or sensing, reasoning, acting, and communication.**
- **Previous work has also identified different technologies: Internet, RFID, context awareness, integration of services, networking capacity, broadband communication, robotics, advanced recognition, entertainment devices, easy authentication, and communication capabilities; collaborative networks, affective computing, machine learning and data mining, and soft computing and causal reasoning; telemedicine, smart homes, assistive communication products, Internet, broadband access, social computing and networking, collaborative networking and software, and design for all; ubiquitous computing (embedded ICT, internet accessibility, mobility), advanced interaction (natural/intuitive and evolving interaction), and algorithmic intelligence (context awareness, learning environment, and proactive environment).**
- **GOLDENWORKERS classification builds on the following classification, previously used in ETICA and capturing the main technologies identified in other research: (1) affective computing, (2) ambient intelligence, (3) artificial intelligence, (4) bioelectronics, (5) cloud computing, (6) future internet, (7) human-machine symbiosis, (8) neuroelectronics, (9) quantum computing, (10) robotics, and (11) virtual and augmented reality. These technologies are not independent of each other but rather interact to create new service opportunities.**
- **The most relevant technologies for GOLDENWORKERS and the focus of the project are: (1) Ambient intelligence, (2) Augmented and virtual reality, (3) Affective computing, (4) Robotics, (5) Internet, (6) Invasive technologies, (7) Quantum computing, and (8) Design approach.**
- **As important as technologies are the design approaches to the use and deployment of these technologies. Concepts such as immediate and remote design, co-design, empowering design, life-based design should be integrated in creating ICT for goldenworkers.**
- **Disabilities as people age are often associated with hand, eye and hear that are the most important senses for current ICT products.**

ICT is gaining an **increasingly important role as an enabler** in many businesses within but also outside ICT development and knowledge intensive expert type of working profile. ICT solutions are often brought in to improve efficiency, yet the adoption of the systems may be slow and user acceptance low due several reasons:

(1) the usability of system may be low,

(2) the new way of doing things with new tools may be not designed to fit to the other procedures of working environment and

(3) training of new solutions is arranged poorly.

When first computers were brought to the various “ordinary” working environments (e.g. offices, banks) over 30 years ago, the big dilemma with ageing workers adaption to the new kind of tools already appeared. **People over forty and fifty where already then struggling with new tools.** The same kind of situation happens over and over again and without age related dimensions when e.g. new ERP (Enterprise Resource Planning) systems are introduced to the organisations. In many

cases these systems are not user-friendly and brought to the workers in a top-down approach. It is important to design the changes with the whole work community to commit everybody and to take into account different phase of career, different life situations, personal characteristics and preferences of individuals.

There is a **growing use of ICT within Member States across all age groups** including older adults however there is also worries about influences of possible "**digital divide**." In recent FUTURAGE (2011) roadmap this challenge is presented in following way:

"The uptake and use of ICT is still much lower among older age groups, and increasingly a 'digital divide' is observed and opening up as the gap between different generations grows. As European societies become increasingly reliant on ICT and the internet in particular, as a medium for retail, media, public service delivery and social interaction, this **digital divide represents a growing risk for the exclusion of older people from the community and the labour market**. Therefore eliminating the digital divide represents a major priority for public policy, and future ageing research will have a crucial role in identifying how this can best be achieved.

To support this goal, more research is needed to reveal new ICT utilisation patterns and discover differences between current and new generations of older users. This field includes the analysis of changing social interactions with regard to **virtual networks** and their impact on traditional (also intergenerational) relationships, as well as of new services and social/health care available through more user-friendly ICT solutions."

**Digital divide represents a growing risk for the exclusion of older people from the community and the labour market**

## 4.1 ICT AND AGEING

Ageing–related technological innovations could help ageing workforce to feel well and stay at work longer or even change working profile according to life course slightly or in some case more radically. The technological solutions and applications that are designed for ageing workforce could be potentially utilised by all age groups in working environments, In that sense so called Design for All approach is also suitable to the work related development of ICT: everyone can find it useful to use e.g. more personalised, embedded, and adaptive application despite his/her age. On the other hand, some solutions and applications could be more age-dependent than others and keeping that in mind it is useful to examine previous remarks on this perspective. Although some of these aspects clearly relate to the well-being of older adults in non-work-related settings these aspects may have point of resemblance also in working environments as such.

### 4.1.1 TECHNOLOGIES FOR AGEING

Ageing–related technological innovations have been clustered into four categories when developing technologies for the future of aging services (Cast 2003):

**Enabling Technologies** will allow the elderly to do more for themselves and to stay in their own homes or independent settings for as long as possible. "Smart Home" technologies for example, can monitor changes in daily activities to detect potential health concerns.

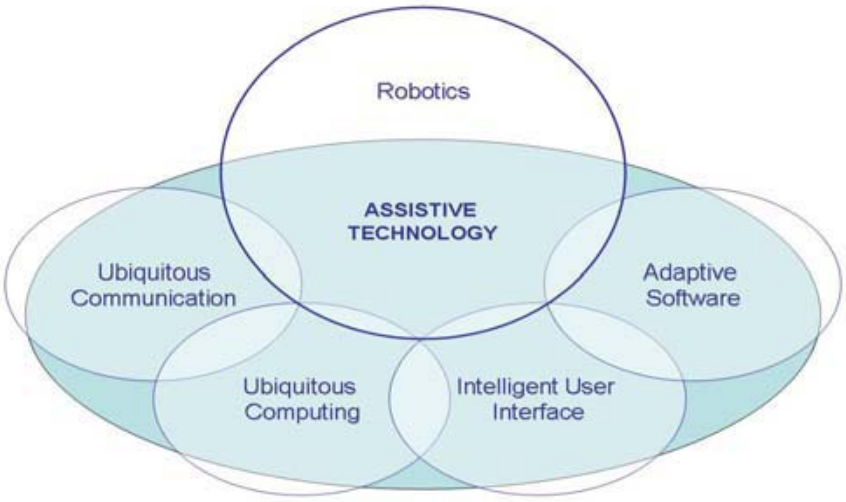
**Operational Technologies** can help medical professionals create healthier work environments while reducing costs, preventing medical errors and increasing productivity. For example, the use of robotic assistants may help the elderly with eating, taking medications or calling for emergency help.

**Connective Technologies** can help ensure a healthy and collaborative relationship between the elderly and the family and caregivers. Whether through the PC, phone, TV or other device, connections can be created that can create a community based around the needs of the elderly. For example, family members can interact from a distance with loved ones, monitor data on daily routines, and thus have greater input and involvement in their relative's care.

**Telemedicine** can allow a medical source to monitor patients from afar. Studies have demonstrated that tele-health equipment can significantly cut emergency room visits and improve the quality of care. For example, treatment of diseases such as diabetes and congestive heart failure —examples of conditions that often deteriorate when continuing care does not take place— can benefit from the uninterrupted monitoring available through telemedicine technology.

The Senior project (2008e) addressed the different fields of ICT for elderly as presented in **Figure 31**.

**Figure 31: ICT for elderly**




The AALIANCE roadmap (2009) identifies specific enabling technologies and functions for Ambient Assisted Living:

**Sensing**: anything and anywhere: in-body or on- body, in-appliance or on-appliance, or in the environment (home, outdoor, vehicles, public spaces, etc.).

**Reasoning**: aggregating, processing and analysing data, transforming into knowledge within different and often cross-connected spaces (body, home, vehicle, public spaces).

**Acting**: automatic control through actuators, feed- back (e. g. information, suggestions, guidance) - local or remote (e.g. call centre), instantaneous (e. g. in the case of alarms) or delayed (e. g. in the case of trend information and lifestyle recommendations) to relevant participants using personalized multi-modal interfaces, possibly across multiple spaces.

**Communication**: Sensors and actuators are connected to one or more reasoning systems that in turn might be connected (even dynamically, e.g. a person moving from home to vehicle to some public space) to other reasoning systems, possibly with their own sensors and actuators.

**Interaction**: intelligent interaction with systems and services is a very important aspect for applications and will have specific requirements in order to cope with the abilities of users.

Technological trends that will foster and shape especially future AAL applications are following according to AALIANCE roadmap (2009):

- **The Internet**, which will be available in every device – the Internet of Things will enable internal and external support systems at home.
- **RFID capable devices** (including Near Field Communication (NFC), Electronic Product Code (EPC), etc.), which will penetrate daily life.
- Concepts of **context awareness**. The Assisted Living (AL) system may in future have awareness of the presence of a user, location, devices and date/ time, etc. This requires presence-detection capabilities.
- The **integration of services**: devices that can be directly connected even to external services.
- Increasing **Networking capacity**, which is, enabling video and multimedia communication between homes and the outside world.
- **Broadband communication** is becoming more and more available at home, but also on portable equipment. (There are however large differences in the availability of broadband in different countries or regions and in the usage of different age groups.)

- The rise of **robotics**, i. e. self moving devices in care.
- **Advanced recognition** of user states, i. e. susceptibilities, feeling, faces.
- Integration of **entertainment devices**. The trend towards standardisation (UPnP, DLNA, etc.) and entertainment devices capable of communicating with other such devices.
- **Easy authentication** systems: advanced authentication systems may develop in the future that are easier to use.
- **Communication capabilities** in home artefacts – inside devices and – beyond that – embedded in the house.

In ePAL (extending Professional Active Life) project the primary objective was to consider and define new ways of promoting a **balanced active life for retiring and retired professionals** in Europe. ePAL developed a roadmap (2010) where following technologies were presented as the most promising ones for support of the specific requirements and characteristics of senior professionals and their continued enjoyable active working and co-working:

- **collaborative networks**,
- **affective computing**,
- **machine learning** and **data mining** and
- **soft computing** and **causal reasoning**.

In Technology Baseline & Trends (2010b) deliverable, the BRAID project identified eight families of ICT solutions for ageing as a reasonably comprehensive set that addresses the needs of the elderly. In this task BRAID unified and leveraged the results of AALIANCE, CAPSIL, ePAL, SENIOR and other FP6/FP7 programmes.

Families of ICT in ageing solutions that BRAID identified are the following:

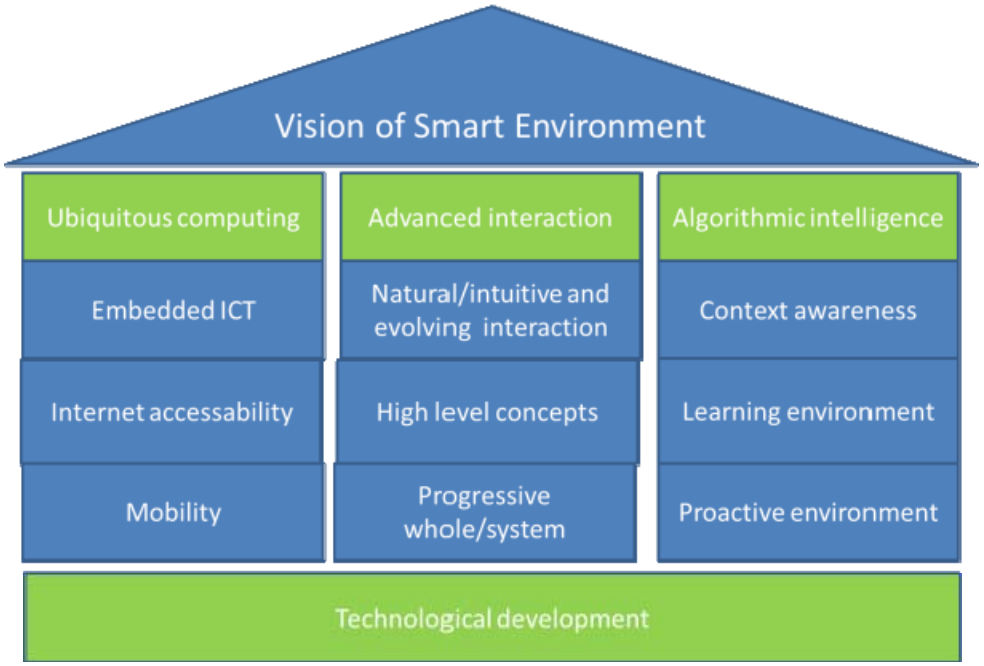
- **Telemedicine**: ICT solutions that enable **monitoring of health status** and healthcare activities, and that enable communications amongst elderly patients, care-givers and service providers
- **Smart Homes**: ICT solutions that **sense the needs of the elderly** in expanding the scope of their activities safely and securely. An essential aspect of these solutions is the interaction amongst people and the local surrounding physical environment. In spite of the label, *Smart Homes*, these solutions cover other thematic settings, and may be interpreted as smart spaces.
- **Assistive Communication Products**: ICT solutions aimed at enhancing the communication abilities of the elderly to engage in desired person-to-person communications and person-to-machine communications. Often appear as ICT enhancements to assistive technologies.
- **Internet**: The ICT solution that is the internet, enabling diverse applications from information access to e-mail to social connections and beyond. Includes developments in the world-wide-web, e.g. Web 2.0 and tools that promote security and privacy that must accompany being online.
- **Broadband Access**: ICT solutions that provide broadband (or high-speed) access to the internet and other applications. These solutions include the infrastructure that provides an enhanced experience for its users and is specifically distinguished from the Internet family above which may be accessed using broadband or narrow-band (dial-up modem).
- **Social Computing / Social Networking**: ICT solutions that enable the facile creation and implementation of social communities of users. Typically, social networks exist on the basis of shared interests and shared user characteristics, e.g., Facebook, MySpace, LinkedIn, etc.
- **Collaborative Networking / Collaboration Software**: ICT solutions that allow for the creation and participation of different communities of seniors as they engage in the pursuit of group goals.
- **Design for All**: This is not so much an ICT solution family as a discipline that enables the optimal experience, interaction and intensity of use of all ICT solutions through fundamental design principles.

The project EASE (Ecological Approach to Smart Environments) performed profound analysis and research-based evidence to support the design of **smart environments**. Furthermore, the aim was to analyse the design issues related to the smart environments and offer some general guidelines for the design of

smart environments in different application areas.

In EASE vision of smart environment was described in three tracks: **ubiquitous computing**, **advanced interaction approach** and **algorithmic intelligence** (Kaasinen and Norros 2007) (**Figure 32**).

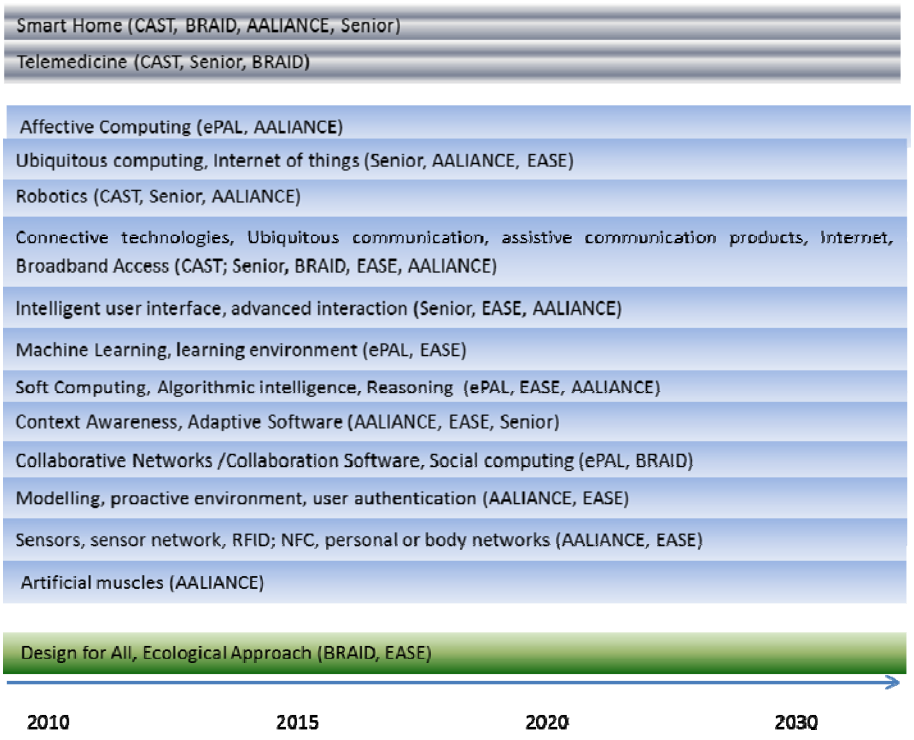
**Figure 32: Smart environment**




We can now examine how different recent roadmaps and selected research projects (that has focused on aging population or in general to future technologies) has classified IC technologies (**Figure 33**).

We can separate from classifications **design approaches** (green), **technologies** (blue) and **application areas** (grey). Because these documents focus on the technology aspects, ethical issues are not seen as design issues although they are presented in the different roadmaps. According to the roadmaps, these technologies have **different natural contexts** of use in everyday life focusing on aged and not just smart homes or telemedicine. However, these were mentioned as technology areas themselves. The different technologies mentioned here are naturally linked to each other and some of those integrate many of the "lower level" titles. For example robotics or affective computing integrate many other enabling technologies. Also **detailed analysis of the potential of these technologies in the future is challenging**: many of these technologies have been under development for many years. The potential strength of those technologies in the future is very much context-dependent and linked to the development of other technologies. Also potential to contribute to the area of active aging at work is almost infinite considering all possible situations for all possible working groups and individuals.

**Figure 33: ICT classifications**




## 4.2 TECHNOLOGIES FOR AGEING AT WORK

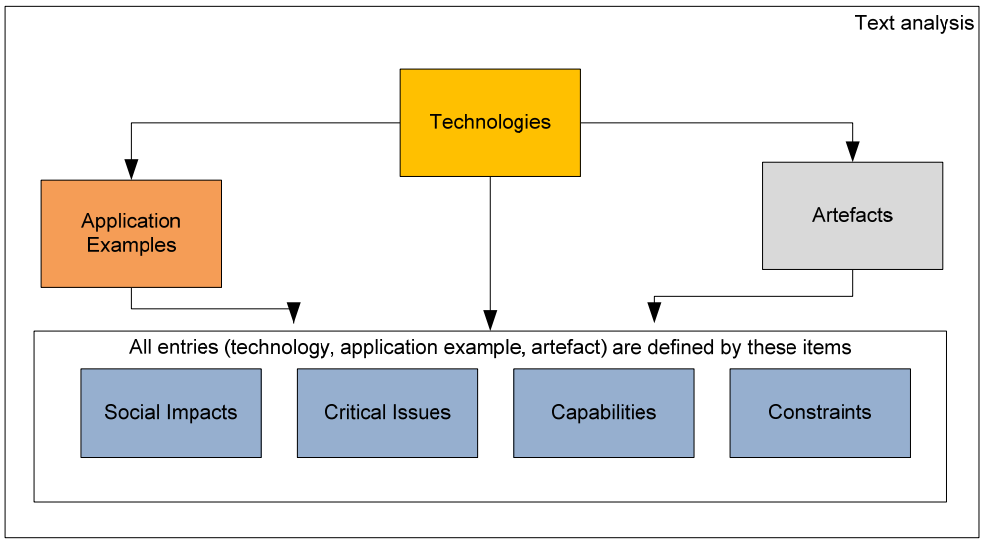
Although this kind of work is challenging, we have recently made very thorough rehearsal in this theme in **ETICA project**. The ETICA (2010) project presents a discourse analysis that led to the identification of approximately **70 technologies**, **100 application examples** and **40 artefacts**. On the basis of this data analysis approximately **11 candidates for technologies of high relevance** were identified. These technologies were then described in more depth constructing detailed encyclopaedia entry-like documents which were called "meta-vignettes". These meta-vignettes describe a number of application areas and examples for each technology and outline core features of the technologies (**Figure 34**).

The following technologies were deemed to be of core importance and each described in a meta-vignette:

- Affective Computing
- Ambient Intelligence
- Artificial Intelligence
- Bioelectronics
- Cloud Computing
- Future Internet
- Human-machine symbiosis
- Neuroelectronics
- Quantum Computing
- Robotics
- Virtual / Augmented Reality

This work comprehensively integrates both technological and non-technological issues about emerging technologies and fully covers technologies presented in other roadmaps. Therefore, we use this **classification scheme** in structuring the analysis of ICT for goldenworkers and for the next phases of scenario building and roadmap. Here are condensed descriptions of different technologies. More detailed descriptions can be found from **http://www.etica-project.eu/**.

**Figure 34: Grid for identifying emerging ICTs and their impact on working environments**




*Adopted from ETICA project*

### 4.2.1 Affective Computing

In contrast to most of the mainstream of computer science and artificial intelligence, Affective Computing does not focus exclusively on the "rational" aspects of intelligence, but also gives attention to **"emotional" aspects**. It has been shown that the human brain does not have separate areas for rational and emotional thinking. It has also been shown that decision-making in humans has a strong emotional component, even if the result does appear "rational": a purely rational intelligence would probably never come to any decision. The main application area for affective computing is the design of **user-computer interfaces** with the aim of making these more "**user friendly**". This is accomplished by **reading "cues" hidden in human speech, facial expressions, body gestures and movements**. The computer adapts and appears to display empathy for the user's current emotional state. At best, computers appear to display emotions of their own. Whether they will ever be able to do so is a matter of controversy.

### 4.2.2 Ambient Intelligence

Ambient Intelligence is perhaps the most pervasive vision for future ICTs currently existing. It is **convergence of three** underlying technologies: **ubiquitous computing**, **ubiquitous communication** and **intelligent user-friendly interfaces**. It attempts to place the user at the centre with the goals of assistance, optimising and relieving the user of repetitive tasks. Ambient intelligence will be extremely unobtrusive through miniaturisation and embedding in the environment, build on a seamless infrastructure enabling the connection of all necessary devices, consist of a dynamic and massively distributed network of devices, have a "natural" human interface, be dependable and secure. Ambient intelligence works heavily with user profiles. European work focuses heavily on applications in healthcare and ambient assisted living, although applications are conceivable for virtually every area of human life and the ultimate vision is a world with ubiquitous ambient intelligence supporting humans in everything they do.

### 4.2.3 Artificial Intelligence

Work on practical implementation of artificial intelligence has been taking place for well over 50 years now. While some researchers have the ultimate goal of creating an artificial intelligence superior to that of humans, much work has been done to build programmes achieving results that would otherwise require human intelligence but not necessarily modelled exactly on processes which take place in the human brain. One branch of AI has focused on building **multi-processor, networked computers** modelled on the human brain (neural networks or massively parallel processing).

AI history can be divided into several phases with heightened interest due to successes followed by so-called AI winters in which public funding subsided due to disappointment following the failure of AI to fulfil hyped promises. The dominant approach in early years was the so-

called **physical symbol system hypothesis** which asserted that intelligence was basically the result of manipulation of symbols by the brain. While this approach has achieved successes, it was realised quite early on that intelligence not only consists of such "cold" cognition, but also of "hot" cognition – desire, feeling pain or pleasure, having emotion.

Recent years have seen the emergence of situated or "nouvelle" AI – an approach which assumes that true intelligence is linked with **having a body which moves around in an environment**. Here, artificial intelligence is strongly linked with robotics.

A related field is "**affective computing**". **Swarm intelligence** is a research field inspired by interactions among social insects. The continued validity of Moore's law suggests that computers will have capacities in excess of that of the human brain in the foreseeable future. Much recent interest has focussed on neural imaging techniques, expected by some to provide a basis for modelling intelligent processes on computers.

It could be argued that the goal of AI is not to build a machine that somehow behaves like an intelligent system, but to come up with an explanation how intelligence by physically embodied systems is possible and could have originated in living systems.

In all, there are currently many approaches to the study and implementation of artificial intelligence with mainly the goal but little else in common. It has been argued that there is a need for a new unifying view of intelligence.

### 4.2.4 BIOELECTONICS

Bioelectronics is a still ill-defined field, although a 1994 bibliometric analysis already defined them as an "emerging interdisciplinary discipline". At that time, bioelectronics would have included what is now known as **neuroelectronics** and also **artificial neural networks**.

Bioelectronics includes electronic (or optoelectronic) coupling of **biomolecules**, or their natural or artificial assemblies, with electronic or optoelectronic devices. It is difficult to clearly distinguish bioelectronics from neuroelectronics. While computers and brains both work with electricity, they each use different charge carriers: electrons and ions. A trick is needed to enable the two to "converse". The trick consists of coupling chips and neurons via electronic fields. Research on the properties of cells and their interactions with the environment has made possible new forms of integration and interaction between biomaterials and electronic systems.

Bioelectronics is promising for medical devices (implants, biosensors for monitoring purposes) but it also has lots of wider developmental opportunities for different areas. Applications include nanorobots, biological computers, biosensors, biochips, implants able to communicate with nerves, artificial stimulation of nerves, artificial touch and artificial organs.

Much research in the field is now related to the **nanoscale**. Attempts are also being made at growing arrays of neurons on chips cultured onto metal or silicon substrates (multi-electrode arrays) for use in computing. Defining features are miniaturization, "invisibility", integration with the human beings as wearables or implants, potential for constant monitoring, treatment of previously uncured diseases and injuries, control over mind and body including the potential of remote control of people.

**Quantum computing** can be seen as an enabling technology for biocomputing which is mentioned as an application area for bioelectronics.

A vision related to bioelectronics is a brain implant on the basis of a chip able to control both perception and awareness, but this is still far from being realised.

### 4.2.5 CLOUD COMPUTING

Cloud computing is a recent trend in ICT that moves computing and data away from desktop and portable PCs into **large data centres**. It basically means that software, various kinds of services and applications are all delivered over the Internet as well as to an "actual cloud infrastructure" (Dikaiakos et al 2009, Fenn et al /Gartner 2009).

From a user point of view, it means that users can access their files, data, programs and other services that are hosted by other service providers from a Web browser via the Internet (Won 2009).

On the other hand one can also look at Cloud computing from a more general view point and define Cloud Computing as a style of computing where **scalable and elastic IT-enabled capabilities** are delivered as a service to external customers using Internet technologies. As enterprises seek to consume their IT services in the most cost effective way, interest is growing in drawing a broad range of services (for example, computational power, storage and business applications) from the "cloud," rather than from on-premises equipment. The levels of

hype around Cloud computing in the IT industry are deafening, with every vendor expounding his cloud strategy and variations, such as private Cloud computing and hybrid approaches, compounding the hype (Fenn et al /Gartner 2009).

**Future Internet is a network of networks that includes advances in the current Internet technologies related to performance, reliability, scalability, security and high level mobility**

### 4.2.6 FUTURE INTERNET

Future Internet is the name for **developments of the Internet** beyond the so-called web 2.0. The latter designates the transition from an Internet consisting of static pages for viewing via a browser to a state where it is no longer possible to clearly distinguish producers and users of web pages.

It is currently unclear whether "future internet" will be an incremental, evolutionary development of the currently existing Internet or whether a totally new Internet architecture will be required.

Current Internet is struggling with slowdown and congestion, largely due to the explosion of video traffic being exchanged. There are also security problems for such applications as home banking and e-commerce, partly because the original architecture of the Internet did not foresee applications of this nature.

Future Internet is a network of networks that includes advances in the current Internet technologies related to **performance, reliability, scalability, security and high level mobility** among others but in addition to that it extends the Internet into the physical world in ways that have not been possible before. Adding semantics will also enable better ways of organising and using the information in the networks which will add to the usability of FI. The two main concepts that distinguish FI from the current Internet are the **Internet of Things** and **Semantic Web**.

### 4.2.7 HUMAN MACHINE SYMBIOSIS

The notion of "human-machine symbiosis" can be traced back to ideas proposed by J.C.R. Licklider (1960) in the 1960s in which humans and machines were to be coupled in ways enabling humans to perform tasks beyond their natural capability. This gave rise to scientific activities concerned with shaping the human-computer interface and with ways to enhance human intellect through the use of computers.

In this context, **symbiosis** is defined as a close, prolonged association between two or more different organisms of different species that may, but does not necessarily, benefit each member.

The above definition suggests that **human and machine** can work and interact to mutual benefit. However, this may not always be the case as such mutuality can mean that one agent benefits over the other or indeed that the agents do not actually benefit from each other at all and instead bring potential harm. It is due to the latter that ethical issues may arise and therefore the need to understand the associated risks is cardinal. These of course will be covered in the critical issues area. Looking at this definition of symbiosis, the implication is that the interaction between man and machine can have both a positive and negative effect. The positive effect is evident in how the machines improve and enhance human life while the negative aspects lie in the problems that the technology brings to its intended users.

Strictly speaking, it is difficult to recognise a genuinely symbiotic relationship in the technology, since the computer is not an actor and does not benefit from the relationship with humans except perhaps through an enhanced reputation due to its usefulness.

It is difficult to precisely distinguish "human-machine symbiosis" from bioelectronics or neuroelectronics as will become apparent in the discussion of applications currently under development.

### 4.2.8 NEUROELECTRONICS

There are, roughly speaking, three branches in neuroelectronics. Each branch uses different devices to interface with the brain, and each of these devices has different features. The first branch, **neuroimaging**, uses techniques such as fMRI, PET, MEG or EEG, amongst others, to visualise activity in the brain, matching patterns to diagnose disorders or to study the brain. The second branch, **BCIs**, uses invasive or noninvasive electrodes to interface with the brain, i.e. to send signals not for diagnostic or research purposes, but to control external devices such as wheelchairs, computers or airplanes. And the third branch, **electrical neural stimulation**, builds on BCI to use invasive electrodes to send

electrical signals to specific parts of the brain, e.g. to alleviate symptoms of nerve-related disorders such as Parkinson's or Alzheimer's diseases. The only defining feature these three branches have in common is that they interface electrical devices with the brain, either to monitor activity of the brain or to send electrical signals to the brain. In overview:

- Neuroimaging technologies register information from the brain to diagnose disorders or study brain structure or function.
- BCIs draw information from the brain to control external devices such as wheelchairs, prostheses or computers.
- Electrical neural stimulation devices stimulate parts of the brain so that symptoms like tremor, clinical depression or pain are reduced.

Neuroimaging itself has two branches: (1) structural imaging, which tries to map the structure, or anatomy, of the brain, and (2) functional imaging, which examines functions of (certain areas of) the brain. The latter enables a researcher to directly visualize how information is processed in different areas of the brain (European Technology Assessment Group, 2006). Both structural and functional neuroimaging are used for diagnostic as well as for research purposes.

BCIs, sometimes called **brain-machine interfaces** (BMIs), are an emerging neurotechnology that translates brain activity into command signals for external devices. Research on BCIs began in the 1970s at the University of California Los Angeles (UCLA). Researchers at UCLA also coined the term brain-computer interface. A BCI establishes a direct communication pathway between the brain and the device to be controlled. Such interfaces are mainly being developed for medical reasons, because there is a societal demand for technologies which help to restore functions of humans with central nervous system (CNS) disabilities (Berger, 2007). Patients for whom a BCI would be useful usually have disabilities in motor function or communication.

### 4.2.9 QUANTUM COMPUTING

Quantum computation follows a model that combines the concept of quantum physics to extend classical information theory, whereby the fundamental architecture opens the possibility to **improve on the previous binary architecture of transistor based processing**. Such calculation using quantum super position, embracing 0 and 1 as a whole and including its distinction brings computation to a higher level.

"In the classical model of a computer, the most fundamental building block, the bit, can only exist in one of two distinct states, a 0 or a 1. In a quantum computer the rules are changed. Not only can a "**quantum bit**", usually referred to as a "qubit", exist in the classical 0 and 1 states, it can also be in a coherent superposition of both. When a qubit is in this state it can be thought of as existing in two universes, as a 0 in one universe and as a 1 in the other. An operation on such a qubit effectively acts on both values at the same time. The significant point being that by performing the single operation on the qubit, we have performed the operation on two different values.

Likewise, a two-qubit system would perform the operation on 4 values, and a three qubit system on eight. Increasing the number of qubits therefore exponentially increases the "**quantum parallelism**" we can obtain with the system. With the correct type of algorithm it is possible to use this parallelism to solve certain problems in a fraction of the time taken by a classical computer". (Bone and Castro 1997).

Quantum computation is strongly expected to efficiently solve some of the most **difficult problems in computational science** (such as integer factorisation, discrete logarithms, and quantum simulation and modelling that are intractable on any present or future conventional computer) and in a way change dramatically the development and implementation of information and communication systems of the future.

"Pushing at the boundary between the quantum world and that of classical physics means using ever larger molecules to see where decoherence destroys superposition. But the bigger the molecule, the harder it is to control outside forces and stop them from disrupting the molecule's delicate quantum state. For large molecules, uncontrolled decoherence effects rule, spoiling the very effect you want to measure."

### 4.2.10 ROBOTICS

Robotics, like its close relative artificial intelligence, has been in existence for a considerable number of years now. Industrial robots are well-established and the debate on their diffusion, which was usually related to impacts on jobs, has largely subsided. The reason for treating robotics as an emerging technology is the ongoing research to free robots from their cages, to create **highly mobile and autonomous robots capable of reacting to**

**cues given by human beings**. Visions include humanoid robots inhabiting the same spaces as humans and other living creatures, sometimes providing services and sometimes working in harness to accomplish tasks beyond the capability of humans.

There is currently no uniform agreed definition of “robot”, although the international standard ISO 8373 defines them as "an automatically controlled, reprogrammable, multipurpose, manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications.” However, mobile robots are increasingly being designed for applications outside of industry. These must have the facility to acquire information from their environment and to adapt their actions according to this information.

In principle robots can come in many shapes and sizes but the typical industrial robot which exists in numbers of many thousands has a single arm, is fixed and programmed to do a single task, such as welding or spraying automobiles. It is isolated from humans for reasons of labour safety. More recent developments have produced so-called **softbots**, or virtual robots, which are programmed to autonomously perform tasks on the internet and in other virtual environments. There is great military interest in the development of robots capable of replacing human soldiers and superior to them in physical and psychological respects.

An important element in all robots is provided by computer programming, usually based on research in “artificial intelligence”. Other contributions are provided by electrical engineering and mechanical engineering. One could argue that robotics is a converging technology, because it is an interdisciplinary engineering discipline where multiple fields converge.

It is predicted that future robots will emerge in the military, household and healthcare. Examples include service robots in households, robots as companions, robots as soldiers, robots for therapeutic purposes and robot swarms for surveillance, microassembly, biological, medical, or any tasks where a collective action can provide a greater benefit than a single unit or small groups of robots.

**Augmented Reality is the use of generated virtual imagery with an application that augments the real physical world by extending its visual elements with information**

The building blocks of robotics include electrical engineering, mechanical engineering and AI. It is sometimes argued that robotics is a branch of AI, because robotics depends crucially on research in AI. The design of robots also relies on human-robot interaction research which draws from (cognitive) psychology and philosophy. Robotics is also related to the ubiquitous computing, internet of things and ambient intelligence visions. Ubiquitous computing is the idea that computing devices are everywhere. Internet of things is the idea that computing devices are increasingly (wirelessly) interconnected and form intelligent networks. Ambient intelligence is the idea that electronic devices in our homes, offices, hospitals, cars and public spaces will be embedded, interconnected, adaptive, personalized, anticipatory and context-aware. Robots in households and healthcare (and perhaps in other areas as well) nicely fit into these visions. Robots are likely to be connected to other computational devices and could in this way be part of an ambient intelligence system.

### 4.2.11 VIRTUAL/AUGMENTED REALITY

Virtual reality is the **software three-dimensional representation of an environment** which can either be modelled on a segment of the real world or on a partly or entirely imaginary world which does not necessarily correspond to anything existing in reality. Users can explore such worlds using suitable software.

In contrast Augmented Reality is the use of generated virtual imagery with an application that **augments the real physical world by extending its visual elements with information**. Such supplementary elements are usually displayed on suitable hardware, such as sunglasses or mobile phone displays.

Azuma et al (2001) define augmented reality (AR) as systems with three characteristics:

1. Combines real and virtual objects in a real environment;

2. Runs interactively, and in real time; and

3. Registers (aligns) real and virtual objects with each other (p.34)

VR originally referred solely to completely immersive virtual reality or virtual environments. The term virtual reality is now also used to describe non-immersive or partially immersive applications, although the boundaries between these categories are becoming obscure (Beier 1999). Regardless of the terminological details, VR has many advantages over fully immersive virtual environments, for example the virtual objects of virtual reality convey information that is helpful in performing real-world tasks. In a completely immersive environment the user is unable to see the world around him while completely immersed inside a synthetic environment whereas partial immersive VR allows the user to observe and to operate in real world situations.

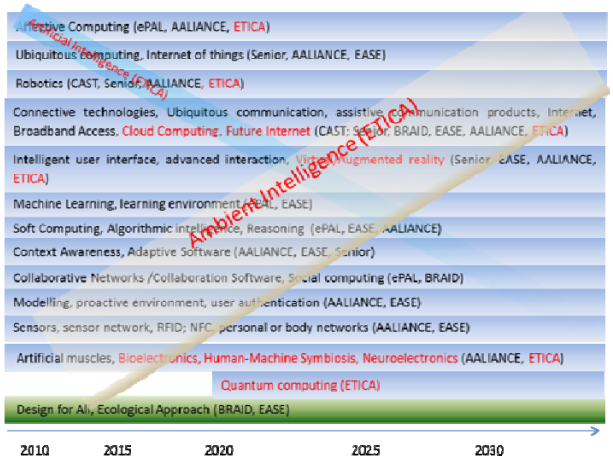
By **supplementing reality with virtual objects** the user is able to perceive the environment more comprehensively than he or she would be able to directly detect with his or her own senses. Consequently the partial immersion enables the enhancement of the user's perception of and interaction with the real world.

Virtual reality makes it possible for humans to visualize, manipulate and interact with extremely complex data and with computers. From an interaction point of view virtual reality has been described as an interface that involves real-time simulation and interactions through multiple sensorial channels (Cline 2005). The simulation can be of either real or an imaginary world.

The technology may consist of a display device such as a mobile phone, PDA or a head-mounted display that shows the real physical environment on which it overlays digital information in a superposition. Augmented reality thus enhances the real environment by an interactive overlay.

Integrating ETICA classification of technologies to the other previous technology roadmaps gives us a good basis to the further exploration of IC technologies potential to support active aging at work in different levels and in various time scales. More important than titles or names of the technology is the characteristics and functionalities that are behind title. Our aim is to build up tool where different technological characteristics can be mixed with different working environments and at the same time taking into account other relevant dimensions in construction of scenarios (**Figure 35**). In that sense we do not give so much emphasis on technology itself but more that what we can do with it.

**Figure 35: ICTs across roadmaps**




After this rehearsal we focus on a first phase of the analysis on the following technologies as most relevant in work contexts:

- **Ambient Intelligence (AmI):** AmI integrates in its big vision other "smaller" technologies and visions. Some of the enabling technologies that will establish concrete vision or parts of it are already there and have been under development for several decades (e.g. Artificial Intelligence, Sensors, Networks, Internet, Ubiquitous computing, Internet of Thing, Ubiquitous communication, Modelling, User authentication, context-awareness). AmI is at some level already here but will be accomplished in a more holistic way in the future. In this sense, it offers a good perspective to consider both current and future design of working environments for aging workforce.
- **Augmented and virtual reality (AVR):** It is a more specific case of AmI or Smart Environment. Virtual and augmented reality changes people's experience of an environment by either replacing the experience of a real environment with a virtual one or adding virtual elements to the real environment. Already currently used in many work-related applications and visions of the future offer very interesting point of view to consider possibilities or threats especially when considering aging workforce.
- **Affective Computing (AC):** AC offers more future-oriented special view to

future as emotions are not very widely yet used in our ICT based applications. Affective computing can be included as part of the AmI vision and one of the enabling technologies is Artificial Intelligence.

- **Robotics (R):** Robotics offer perspective both to the current and future oriented visions. This special area of technology has been included to the visions of AmI and Smart Environments and linked closely to the development of Artificial Intelligence and other "smaller" or more specific technologies. Robotics has been widely utilised in working environments as automation and assembly technology (i.e. replacing human physical work). Robotics as a human companion or co-worker in work environments is still more like future scenario but should be analysed carefully especially when considering aging workforce.R is related to also the issues of human augmentation in general.
- **Internet (I):** Although it is more like platform or enabling technology for bigger visions, it itself has so tremendous influence with its specific development (e.g. Cloud Computing, broadband access, ubiquitous communication, Internet of Thing sensors, networks, ) tracks that it should be handled separately. Internet has shaped our working environments widely already in specific areas and it will have same influence also in the future.
- **Invasive technologies (IT)**: Neuroelectronics, Bioelectronics and Human-Machine Symbiosis have research areas and applications that are both related to the human augmentation with new applications and information delivery to or from human for specific purposes. These technologies are not yet widely utilised in working environments. However, in future respect applications based on this kind of technologies may influence very much also in the case of aging workforce.
- **Quantum Computing (QC):** QCs potential is unpredictable at the moment. As quantum computation is strongly seen to efficiently solve some of the most difficult problems in computational science and in a way change dramatically the development and implementation of information and communication systems of the future it offers very interesting perspective to analyse quite future oriented, imaginary scenarios related to the aging workforce.
- **Design Approach (DA**): In related to the working environments and aging workforce we should emphasise especially human driven design approaches. Although different technologies may have great possibilities to improve quality of work life and quality of life in society in general there are also threats that have to be considered very carefully when developing, designing and implementing technologies and applications for the specific purposes.

### 4.3 ICT AND AGEING IN WORK CONTEXT

The existing recently published roadmaps (e.g. AALiANCE, ePAL, BRAID) provide valuable starting point for work-related technologies. The **AALIANCE** roadmap (2009) further emphasizes the specific use cases for ICT in the workplace:

- To facilitate access to workstations;
- To assure the right working conditions related to the environment and personal situations;
- To support work activities;
- To prevent and reduce the prevalence of work-related diseases;
- To supply tools for teleworking;
- To provide safety and health regulation for employees

In **ePAL's** technological perspective (2010), three pre-conditions are specified as required for the success of extending professional active life of seniors, including:

- Availability and use of computing resources e.g. pervasive computing and communication links for all senior professionals must be supported.
- Establishment of virtual communities of seniors to work together on solving emerged problems in the market/society, and performing individual and/or joint tasks.

- Provision of advanced ICT technology and support tools targeting senior professionals and their working/co-working.

In their roadmapping strategy, ePAL (2010) identified four fundamental ICT related areas in need of further research and development for support of the specific requirements and characteristics of senior professionals and their continued enjoyable active working and co-working, namely:

- **Collaborative Networks**: Specification of a reference model for ePAL environment to capture all its endogenous elements (i.e. components, structure, functions, and behavior governance), as well as the exogenous interactions (with the constituents, market, society, and support providers). This model is required to facilitate the study, understanding and developments for ePAL.
- **Affective Computing**: Design and prototyping tools and systems to support the needed functionality and operation, with specific attention on behavioral aspects of senior professionals and ePAL communities.
- **Soft Computing**: Design new approaches and tools to on one hand reduce risks and frictions, and on the other hand boost and motivate collaboration and co-working among ePAL stakeholders. Here the issue of trust, mediation, rewards and incentives, value systems, etc. comes up which all deal with incomplete and imprecise information, and thus their soft modeling and qualitative analysis are required.
- **Machine Learning**: Specification of models and tools assisting seniors to leave their legacy behind, learning from their practices. Designing new tools for decision making through learning from past experiences and through ranking solutions with pre-defined indicators.

**BRAID** (2011a,b) has considered **Occupation in Life** as one of the life settings where technology can support the continuation of professional activities either with a salary or on a voluntary base. BRAID notices that similar to the other life settings, occupation in life can look very different for each individual, depending on the background work structure, sector, individual goals, capabilities, flexibility, opportunities, and functional ability. Some examples of cases to be considered under this life setting supported by ICT for BRAID include:

- Adaptation of working conditions,
- Mentoring / Coaching / Consulting,
- Team work,
- Inter-generational team work
- Leaving a legacy.

**GOLDENWORKERS** acknowledges those roadmaps contribution to the research theme: ICT, aging and work. Goldenworkers objective is to look further to the future and tackle those specific and qualified but also holistic research challenges for applying innovative ICTs to support an ageing workplace. In that sense, it will integrate **ICT innovation with socio-economic evolution** to outline the mechanisms to have these technologies facilitate ageing at work. It will define scenarios where work, ICT and age are integrated and managed. All employees, but in particular older workers, will benefit from this approach, as workers will be able to prolong their career and improve the overall quality of their working life.

Yet, ICT **research challenges** regarding active ageing at work are not only **technical**. The challenges include challenges for **design methods**, challenges related to **deployment** and only third challenge is the technology in itself. In the following the three types of challenges are described in more detail.

**Design challenges** include methods with which the increasingly complex, global and networked systems can be designed such that they support the work tasks instead of creating additional problems. Key issue is research on methods and practices that facilitate **co-design**. All actors in different organisational levels whose work will be affected by the new ICT solutions are involved in the design from the very beginning. Another crucial issue is to **integrate design and work practises** so that the ICT solution will support the existing tasks or will create meaningful new practices. Those practices should be designed within the work community so that all relevant actors in different organisational levels can participate. Ageing employees can provide valuable insight of current work practices and the rationale behind them.

**Usefulness and usability** of the ICT solution are crucial. Moreover, the solution should be designed such that user experience is good; using the system should provide feelings such as joy of success, pride of proficiency and feeling of control. Design processes should be developed more multidisciplinary. **Multidisciplinary impact**

**analysis** during the design will integrate analysis of user experience, business value, organisational impacts, safety and ethical issues. ICT tools such as simulations, virtual models, and semantics can be beneficial in the co-design of complex entities that integrate different technologies and employees in different roles.

**Deployment challenges** include **organisational practises** with which changes in work methods and work roles are introduced. Ageing employees should be specifically taken into account when changing their work routines. **User acceptance** of new solutions should be studied and problems should be proactively solved together in the work community. In the future design and use are closely connected, the design continues in deployment and use where the employees adopt usage practises and this may indicate needs to change the ICT solutions as well. Future organisations are increasingly resilient - they constantly adapt to the changing environment both within the company and outside. This requires flexibility from each individual employee and work positions are not as fixed as they have been before. ICT solutions should **support the work practises** instead of managing them. For instance Enterprise Resource Planning (ERP) systems are often not supporting the leadership as planned but they start to manage the whole organisation. Instead of getting support from the system, the requirements of inputting data to the system start to manage the employees (Kallio et al., 2009).

**New ICT technology** may provide ways to support ageing employees but the technology may also introduce challenges. New ICT solutions can be especially challenging to ageing employees because they **may require changes in work routines and practises, and they may require learning new things**.

**New ICT solutions can also provide ways to utilise and enforce the good qualities of ageing employees**

These kinds of threats of new technology should be identified in advance, and in the technology development the specific requirements of ageing users should be taken into account. Important challenge with the increasing level of automation is finding optimal level for automation so that the user remains "in the loop", trusts the system and has a sense of control and presence. New interaction solutions such as gesture-based interaction, interaction with multimedia or augmented reality may require learning and may also be physically challenging to ageing employees.

New ICT solutions can also provide **ways to utilise and enforce the good qualities of ageing employees**. For instance, they may provide ways to transfer the silent knowledge to the younger employees. These kinds of opportunities should be identified and technology research and development in these areas should be strengthened. Promising solution is e.g. ambient intelligence that embeds necessary information to the physical objects with which the information is needed. ICT solutions can support ensuring situation-awareness of the human user so that she can interpret the situation and identify what is important and what to do. **Context-awareness** in ICT systems protects the employee from information overload by providing him/her with situational relevant data. Visualisation techniques may ease viewing and monitoring complex phenomena.

Goldenworkers will imagine with wide involvement from various stakeholders how technologies could affect people's work performance in different working environments in different time horizons. The aim is not to predict future but use that information as basic design information for the future development of technologies in context of use with particular people.

Lots of visions and also real-life implementations have been done in the area of aging and new technologies during last ten years. Considering specifically ICT sector here, Ambient Intelligence has been the all covering big theme in recent years in the area of supporting independent living and enhancing seamless way of utilising different technologies in our everyday environments. **Ambient assisted living** has been commonly used concept to describe the support of ICT in different phases and contexts of person's life. Especially this theme has focused on elderly people over 65 and to the special requirements of them in their everyday life mainly due demographic reasons.

The technological shift of computing, including applications and services directed to two dimensions, **embeddedness and mobility**, has already changed a lot about our relationship to our environment (both social and technological)Technology has always been embedded in our living environment in some way. The technological infrastructure has been fading from our sight as technology has reached a more mature status. In the electronic and computer era

the wires, base stations and servers are usually hidden and we see only our personal technical appliances. However, the embeddedness of technology is now shifting from particular, computer-situated spaces, towards a **computer-everywhere philosophy**. The idea that we have a place where our interaction with our environment is supported by computers is changing. Soon we will have technological components (communicating with each other) everywhere, out of our sight, obtaining and utilising information gathered from the environment (Ikonen, 2009).

The increasing **mobility of information and communication** technologies has also changed our relationship with our environment. With mobile computers we can carry lots of data with us (e.g. books, music and photos), but at the same time we can also create new expressions of ourselves and share this information with others. This connection to the global network enables continuous information-sharing and communication in various ways. When these two dimensions work together, when the person with mobile technology interacts with the situated smart environment, we are approaching the area of ubiquitous (or pervasive) computing, also called ambient intelligence (Ikonen, 2009). The project EASE (Ecological Approach to Smart Environments) performed profound analysis and research-based evidence to support the **design of smart environments**. Furthermore, the aim was to analyse the design issues related to the smart environments and offer some general guidelines for the design of smart environments in different application areas.

Future computerised smart environments are a challenging design target. This issue is especially tricky when designing public places and multi-user environments. Private or semi-private spaces (i.e., work, car, home) can be adjusted more easily according to individual users or a certain user group. It is also easier to compose common rules and regulations for workplaces than for public spaces, for example. One of the great challenges and opportunities would be to integrate the designer and the user again and give control over his computerised environment back to the user .(Ikonen, 2009).

In EASE project (Kaasinen and Norros 2009) different environments of people's everyday activity were separated to three different tracks: living environment, service environment and production environment. Obviously these different tracks are in many cases overlaying each other somehow and depending of actual situation or context. Also emphasise one of these contexts over others is can be changing at every turn. Development of ICT and working environments has indeed pushed people in many jobs towards unclear borders between work and leisure-time. Similar phenomena can be identified in service sector were different services are offered and delivered via ICT location independently. However as main intentions are different in these different environments the perspective and separate requirements are useful to separate with these borderlines (**Table 22**).

As these examples of characteristics of technologies are cross-examined with different technologies we can shift into more detailed descriptions of people in certain contexts. With these scenarios, we can describe at a more natural and comprehensive level with all stakeholders about different aspects of these scenarios.

### 4.4 Designing ICT for Ageing at Work

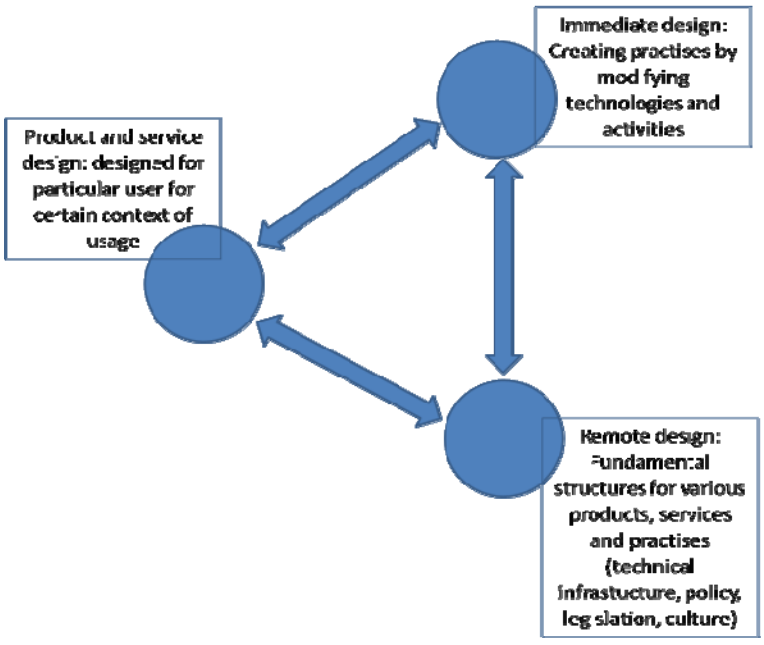
In this section we summarize all concepts and technologies under theme smart working environments. Although we focus here to the question how ICT can be utilised currently and in the future in our work life contexts so that it **really improves our quality of work life**, it also covers all non-technical aspects of designing

working environments. ICT itself can do only one part of the job when targeting to improve our work environment holistically and in worse scenario it may also be the main obstacle for aging workforce to be part of the society if not designed well and holistically.

**Table 22: Technology and environment**

| Environments / Characteristics | Living environment | Service Environment | Production Environment |
|---|---|---|---|
| Embedded ICT | | | |
| Internet accessibility | | | |
| Mobility | | | |
| Natural/intuitive and evolving interaction | | | |
| High level concept | | | |
| Progressive whole/system | | | |
| Context awareness | | | |
| Learning environment | | | |
| Proactive environment | | | |

**Figure 36: Ecological approach to design of smart environments**



As a result of a recent joint effort (Kaasinen and Norros 2007), a theoretical basis for a new design framework for smart systems was presented. The framework was labeled **ecological approach to design of smart environments** (**Figure 36**). The approach states that the traditional product design approach needs to be extended to two new design, immediate design and remote design levels, due the current design tensions and demands. According the framework immediate design focuses on local and immediate user needs and experiences, and emphasises the **increasing role of users in the design**. Design alone or technology by itself cannot create practices but they offer possibilities that users utilise and shape into their practices. **Remote design** is more distant or strategic in a sense that it aims at abstracting from the immediate and creating more general solutions (e.g. physical or technical architecture, standard, platform, political decisions) that provide possibilities and prerequisites for the future.

As a part of the immediate design it is necessary to develop **co-design methodology** that allows different stakeholders to take part to the design as equal partners. Changing the shift from research objects to research partners or stakeholders (research subjects) could be called an Empowering Design practice for potential end-users of a product or a service. In addition empowering design should focus also to other design levels and to the all stakeholder perspectives and not just to the end-users. **Empowering design** practice should give an opportunity to influence to the design in all levels and by different actors so that the dialogue built in design process could be open and mindful between different levels and between different kinds of stakeholders. Part of the empowering design practice is to perform an ethical assessment for the whole design. Ethical issues should be studied throughout the design process: from the requirements gathering phase to the testing including all stakeholders perspectives for the design and implementation of the system (Ikonen 2009).

One structured proposal to shift design from technology driven emphasis to the more human driven approach is **Life-Based Design approach** (Leikas 2009). According to this approach technology should enhance people's ability to carry out actions in different areas of life. There is always a specific reason for adopting and using technology, and this is to reach the goals that people have set for themselves in their everyday life. Technology's role is to serve as a tool to help people achieve these goals in general, and to be able to accomplish them easily, safely, reliably, or comfortably. Even technology that is developed merely for entertainment purposes should fulfil these criteria.

The measure of technology is life, i.e., how much technology is able to enhance the quality of people's lives. Unfortunately ICT technology is perhaps the number one field of technology that has been decreasing the feeling of self-efficacy among older people. It is the experience of many **older adults that the technology in our everyday lives is both complex and difficult** to deal with. Disappointments with new devices easily create the feeling of low self-efficacy and might even affect a person's self-esteem (Leikas 2009).

The rapid development of technology and our much **slower rate of biological evolution** do not go hand in hand. Our body, the skeletal system and muscles, are adapted to function in very different environments than the environment built with the new ICT technology. In fact, although traditional human-factors approaches are often concerned with psychical aspects of product use, quite paradoxically the usage of ICT technology has shrunk our activity to cover only a small area of our body functions. Only the motor functions in our upper body play a significant role in the usage of different technologies. There isn't too much, for example, for the feet to do in this area. Different usage patterns of ICT systems and devices are based on holding out, grasping, pressing and pushing, and require good eye-hand coordination and fluent mobility of upper limbs, hands and fingers. In addition, they require good vision and in many cases, good hearing, also (Leikas 2009).

In fact, the whole activity of using ICT technology is concentrated around the triangle which consists of **the hand, the eye and the ear**. Typical examples of the devices are keyboards, mouse pointers, mobile phones, remote controls, card readers, digital displays of many household machines and touch screens of different automated machines. Actually, the list is endless. Thus, in order to cope with all kinds of technologies in our everyday life we need to have the relevant good capacity at least in our hands, fingers and eyes. However, unfortunately these are the very body parts that will be affected by the age and eventually during ageing will face decline in their capacity. This decline is inevitable and will confront every person. If nothing changes, this will pose difficulties for

each and everyone of us in accessing and using present technologies (Leikas 2009).

There are countless **mistakes** that designers have made in their efforts to **design for older adults**. One example of this is the use of an electronic cash card, which challenges all the functional capacities of an individual. When using it, one is supposed to know how to put the card into the machine, to remember the PIN-code of the card, to write down the code using the small buttons of the card reader and to read the text on the small screen to select the functionalities and follow the orders, and all this while in most cases a queue of people, waiting for their turn, is forming behind. Even if one could remember the PIN-code under these pressures, the system is useless, of course, in case the eyeglasses were left at home. Another example is the mobile phone with all its extensions. The size of the device is too small, the surface too slippery, and the buttons too small and inappropriately designed for use, not to mention the screen which is too small in general as well as the size of the fonts. In addition, for many older people the phone has **too many functionalities**, which only hinder the usage of the most important ones.

Modern technology is **difficult for older adults** for two reasons. Firstly, the **design is not consistent with the experience that older people have** gained of technology in their forms of life. The looks of the devices can be strange and the operations logics unfamiliar. **User interfaces are incomprehensible**, as they do not seem to bear any relation to the life that older adults have lived nor the experiences that they have gained with tools and equipment in their former days. Secondly, the **changes in people's physical and cognitive condition** arise from many problems in coping with ICT technology. The lower levels of the impairments do not normally lead to difficulties in using ICT technology but can easily cause problems in adverse circumstances such as in dark and noisy environments. On the other hand, these hearing, vision and mobility impairments may arise in parallel and combine to make ICT products and services more difficult to use for older people. Physical problems can make holding, e.g., a handset difficult and make keypad or touch screen operation slow and inaccurate. Being in a wheelchair or needing a walking stick can make access to machines and devices difficult. These tasks may also prove painful (Leikas 2009).

### 4.4.1 From Life to Technology

It is not possible to understand what people need from technology if we do not **start the design from life**. Examining and analysing life is always the starting point for technology design. For the designer it is not even possible to consider technology development without considering life because the user and life are always constructed inside technology. There is no technology that would exist outside life. The important question is whether we analyse life only through our everyday knowledge, intuitively and without separating different elements of life, or whether we carry this analysis out scientifically with the help of a systematic methodology.

It is not possible to understand technology in life if we do not fully **comprehend the life itself**. Life is a multifaceted and an endlessly varying phenomenon with countless of dimensions from which it can be examined. This is why life as such cannot be a core concept for technology design. We have to find a concept which could help us to differentiate and accurately define these dimensions. In order to gain understanding on where to go and which aspects to stress in the product design from the user's point of view, it is crucial to understand how the users perceive their everyday life, and what kinds of restrictions and incentives their have in their daily rule-following actions. Thus, enhancing the quality of people's lives, with the help of technology, calls for **responsible design thinking**. Forms of life offer a simple but very usable approach to examine life in all kinds of situations. They define what people do by defining their rule-following actions and attributes in a context. With the construction of a description of form of life it is possible to get an idea about what ICT-designers can do to advance the lives of the people sharing that form of life.

**The aim of Life-Based Design is to bring vital understanding of people's life for the basis of the creation of design ideas and con-cept design**

Defining components of form of life is a focal step in design. Good understanding of a form of life allows designers to understand how people could be supported in their pursuit towards the

goals they have in participating in a particular form of life (Leikas 2009).

### 4.4.2 LIFE-BASED DESIGN PROCESS

The aim of **Life-Based Design** is to **bring vital understanding of people's life for the basis of the creation of design ideas and concept design** and also to guide the whole development process of products and services. It is thus the kind of activity which should be carried out first in the development process. It will produce decisive information for further phases in the development process, such as concept development.

It makes sense to separate Life-Based Design within the conceptual design process. Life-Based Design is conceptual design by nature. Its goal is not a fully defined technical solution to some problem, but a conceptual description of a technology for further technological design. As was mentioned, one cannot design a technology without making assumptions about life, users and clients. Life-Based Design would allow designers to have a rational model and system of human requirements on which the design could be based. Thus, **the outputs of the Life-Based Design process are product and service concepts**.

So far we have introduced form of life from the point of view of analyzing and understanding life. Now it is essential to examine how this concept can be used in a Life-Based Design process. For this reason, this chapter discusses the basic concepts of Life-Based Design and shows how form of life and its associated concepts, the rule-following actions and the attributes of a form of life can be used in a Life-Based Design process.

When we reflect on the course of a Life-Based Design process, it is essential to keep apart the **design actions** and the **evolving design plan**. The design actions are **operations that a designer or a design team carries out to complete the design plan**. Thus, in the middle of a design process the plan is still incomplete, and designers have tasks that they have to carry out to complete the design plan. A description of the design process, and especially the Life-Based Design process, means defining tasks and operations that must be carried out in order to proceed from the concept of life to the actual product or service concept. Basically, the first step in the Life-Based Design process is to define the problem that the designers want to solve. Of course, they have to evaluate whether the final output is worth executing. They have to have an idea what is the worth of the output, i.e., does it improve and contribute to human life, is it ethically valuable, is it realizable, is it cost-effective, does it have a rational business logic and does it have a rational social logic (Leikas 2009).

Secondly, the designers must be able to **link the design plan with the practical form of life**. They have to have a description of how the new design idea can improve the human actions that are intended to be improved. The design ideas must explicate the meaning of the new technology in a future practice. When Nokia, for example, designed its new mobile phone with no antenna, it improved the way we could carry the mobile phone in the pocket and in this way improved the mobile form of life. This is apparently a small but a very elegant interaction innovation. It is good to remember that really important technologies are often based on small innovations.

The third step is the **actual design process**, in which the design plan is divided into sub-problems and these problems are solved on the ground of the knowledge we have about human beings and their actions. Of course, the type of knowledge we need depends crucially on the type of the target user group and the kinds of actions this group is expected to carry out with the new technology (Leikas 2009).

The logic of solving the sub-problems is important. In most cases they have to be solved separately, and there are often many alternative solutions for a specific sub-problem. This means that we have to reflectively make choices between different alternatives. Another aspect is that once we finally have been able to solve a sub-problem, we can incorporate it to the master design plan (Saariluoma et al., 2006). In this way, the final plan is gradually constructed in the design process. To explicate the process of Life-Based Design, it is essential to investigate how knowledge of life, i.e., forms-of life and their rule-following actions and attributes, are used in carrying out the basic product development process. In the following, I will explain how knowledge of human life and its dimensions are applied in each stage of the development process and thus give an illustration of a conceptual process for human-technology interaction design (Leikas 2009).

To summarise, the process of Life-Based Design is an iterative process that includes the following phases:

- defining the design problems through the analysis of a form of life,
- generation of possible design solutions,
- analysis of design alternatives and
- construction of design requirements from accepted design alternatives.

As in any human-centred design, also in the Life-Based Design the **users should naturally be involved in the design process** in different phases. The users' role in the design is to discuss the relevant matters with designers and deepen their understanding of the form of life. This information gathering concerning the particular form of life can be accomplished with the help of, e.g., group discussions, interviews and workshops of people participating in this particular form of life or with the help of ethnographic research. As soon as the design ideas are specific and visualized, the users may again give their views about the concept ideas and thus help in the crystallisation of the ideas. This discussion can be carried out with the help of, e.g., focus groups and different techniques of participatory design.

Users' view should be included in the design of ideas and in concept development. The users should bring their view to issues concerning the purchase, usage and even the disposal of the product. This requires **user involvement in the very early phase of the design** (Dickinson and Dewsbury, 2006; Hawthorn, 2006), i.e., in the phases of the form of life analysis and the definition of technology supported actions. Naturally after the Life-Based Design phase, as the development process proceeds and the focus is shifted on technical implementation, the user input is also needed in testing, e.g., the acceptability and usability of the product prototypes.

In the case of older adults the challenge of user involvement is not in older people's interest towards technology design, as older adults indeed want to influence on what kinds of products and services are developed for their needs (Leikas, 2007). Instead, the challenge is in finding and developing suitable enough **methods that would encourage people to bring forth their views of the design** and ensure efficient gathering and usage of this information throughout the design. The participation of older adults in technology design is useful from two angles of view. Firstly, **older adults experience technology and adapt it in their own way**, which is in many times very different from that of the young. In the design of products and services this tacit knowledge of older people's experience world should be exploited for the benefit of not only older adults themselves but all citizens in the society. When designing only from the perspective of younger people there is a danger that we loose the essential experience knowledge of life that older people have and that is valuable in the information society. The need for this tacit knowledge increases all the time as in the societies there is a strong demand of understanding entities instead of single matters. This understanding evolves within the course of life and is thus typical for older people.

Secondly, no matter how well a product or service is developed, older adults will not adopt it if they find it somehow complex, obscure, confusing, violating privacy, stigmatizing, or unaesthetic (Leonardi et al., 2008a). This is why it is essential to bring their view in the design and let them have their say in a very early phase of the design process.

Life-Based Design stresses the importance or the early design phases, and thus considers design requirements from two viewpoints. Firstly, it covers requirements for concept development. With the help of Life-Based Design it is possible to create product and service concepts and thus specify requirements for concept development. These requirements also guide the product development all the way from concepts to user interfaces.

Secondly, and very importantly, Life-Based Design is concerned with **innovation and creation of design ideas**, a process that is neglected in many current design approaches. When creating design ideas, **understanding people's life** should constitute the main motivation for the design. Life-Based Design examines the rule-following actions and facts and values of forms of life and converts them to design-relevant attributes for the design for life. With the help of these design relevant attributes it is possible to examine the relevance that technology can bring to different contexts in forms of life.

**Life-Based Design does not focus on technology but on forms of life**

What are, then, implications of the Life-Based Design approach to the traditional human-centred design process? How would this approach change the design of ICT technology for everyday use? Firstly, the design should start from strategic studies of **forms of life**. This very first and essential phase can be called FoL

analysis and it should support the design in all its phases. As explained above, FoL analysis can be seen strategically different from traditional concept design. It is anchored in **social and human sciences**, and draws from scientific and experimental information on people's forms of life with the help of verified and established methodologies of these sciences. FoL analysis with the design relevant attributes is thus directed towards strategic management of the design (Leikas 2009).

The generation of design ideas and technology-supported actions aims at making the preferences of the users concrete with the help of technology. Concept design, in contrast, starts in a situation in which it is already known that a new product is needed, and very often the technology to support this need is already decided. Often it accounts also for previous and competing versions of the product, specifying ideas for the actual product design. Therefore, concept design is closer to technology than Life-Based Design. In fact, **Life-Based Design does not focus on technology but on forms of life**. It creates descriptions of concepts from the point of view of user's actions, and can thus be seen both as a preparation phase for concept development, and also as an information source penetrating the whole design and development process. This means, that in different phases of the product or service development, such as evaluations of concept ideas, visualisations and different prototypes, the outcome of evaluation is assessed against the very design-relevant attributes, and the design requirements are refined in accordance with the results of this assessment. Naturally, the size of the design project, the number of different experts and design teams involved and the nature of the design challenge from, e.g., multicultural perspective all influence the iterative development cycle and the role of the design-relevant attributes in it (Leikas 2009).

In the design process model, the information of the forms of life of the users is utilised in the Life-Based Design process and carried along the whole product development process. It supports every phase of the design. The design starts with a **FoL analysis**, which means research on different rule-following actions as well as facts and values of the forms of life of the target users, and determination of design-relevant attributes based on this information. **The technology supported actions are then derived from design-relevant attributes**. The phase is followed with analysis of design alternatives and finally of constructing design requirements.

From here onwards the process is more or less consistent with the traditional **human-centred design** process with concept development, visualisations, state of the art research on different possibilities of technology, and finally the iterative product design as described in the HCD standard (ISO, 1999). The research methodologies here should take advantage of the methodological grounds from, e.g., social sciences and user psychology. The design methods should enable and encourage empathy, speculation and communication, and promote dialogue between the designers and the users as well as in the design team (Knight, 2005).

The analysis of the data of the form of life should be based on state-of-the art conceptual frameworks from the social and human sciences. The technology supported actions are assessed in the light of research on the impacts of different technologies, and the design relevant attributes are set against different possibilities of technology. This data and suggestions and sketches based on them are integrated with different alternatives of technology, and possible marketing information, and modelled into product or service concepts.

The **concepts and their visualisations are then evaluated** with the target users, modified and finally brought into product design. Following the principles of human-centred design, the product prototypes as well as user interfaces are iteratively tested for user experience with users and relevant stakeholders and finally in real usage environment and situations.

There are certain cogent arguments for the Life-Based Design. Firstly, human beings should not be seen as extensions or subsystems of technology. Instead, **technology should be harnessed to support and enhance the quality of people's everyday life**. This can be possible only if the point of view in the design is changed from technology to humans. Secondly, when designing for the quality of life we have to **understand people's everyday life** and what is relevant for people. Thirdly, relevance in respect to technology can be made visible **through values and 'worths' that people have in their life**. Finally, values and worths become visible in different contexts. To understand these contexts and to be able to design worth in them we have to understand different regularities of forms of life (Leikas 2009).

Mere investigation of the elements of form of life is not enough to guarantee successful design outcomes. We need to have well-grounded methods and tools for the design which can

utilise our investigations of forms of life and implement this knowledge into the design work. As discussed already, the traditional human-technology interaction research does not consider everyday life as a relevant element in relation to technology development. Of course, certain elements of HCD, such as user participation in the product design processes, form essential and well-grounded arguments. Indeed, involving users already in the design processes of ideas and concepts may no doubt bring a necessary perspective for the development process.

Despite of this, it can not carry us a long way in the aim of designing products that would be beneficial in the everyday life and desired by people. In order to succeed in this aim we need to find more holistic approaches for the design (Leikas 2009). **Figure 37** provides an overview of the future of these technologies.

**Figure 37: Future of Technologies**

| Technologies /Components /Features | Applications/scenarios (in Context) | 2010 | 2020 | 2030 |
|---|---|---|---|---|
| **Ambient Intelligence (AmI)** | | | | |
| Sensors everywhere + User identification e.g. via mobile device = Context awareness | Adjustable workspace for worker in various working environments | Automatic configuration for various appliances already in some environments available. Not holistically context-aware yet though | Should be mainstream in various working environments | Can take into account even emotional and social context |
| **Augmented and Virtual Reality (AVR)** | | | | |
| Telepresence via AVR applications | Telepresence via AVR applications (e.g. Avatars) makes meetings between various locations almost realistic and thus reduces need for travelling | Videoconference enables telepresence but AVR applications to support telepresence are more still in experimental state | AVR telepresence is successfully implemented in various working environments | AVR telepresence experience is very realistic = it feels that the people in meeting are really in same room |
| **Affective Computing (AC)** | | | | |
| Emotion measurement | Emotions are monitored to avoid work overload or bad stress | Stress is already measures via applications (sleep quality, blood pressure, pulse) | More sophisticated emotion recognition application already in the market and in wide use | |
| **Robotics (R)** | | | | |
| Cleaning robots | Cleaning robots for factories | Already in wide use in various private spaces. Works well in open spaces. More challenging to apply in areas where humans are active or where remarkable obstacles are limiting their behaviour | CRs can perform their tasks even more challenging spaces also in public areas. Real co-partner to human worker with advanced algorithmic intelligence | CRs replace all human work in cleaning work |
| **Internet (I)** | | | | |
| Network for communication via various devices | Various ways of communication (speech, written, videos) via internet | Widely used in different working environments | Communication comes even faster and online via internet enabling applications | People communicate simultaneously with various ways and appliances |
| Cloud computing (CC) = software, applications and documents are stored in cloud or utilised via cloud | CC enables workers to work wherever, whenever and with whoever | Already widely used in working environments | Persons are not using their own computers anymore. More and more applications, software and solutions are delivered for user in ad hoc to everywhere | |

| Technologies /Components /Features | Applications/scenarios (in Context) | 2010 | 2020 | 2030 |
|---|---|---|---|---|
| **Invasive Technologies (IT)** | | | | |
| Brain-Computer Interface (BCI) | BCI enables controlling system directly from brain | Already utilised in supporting communication for disabled. Not really utilised commonly otherwise in working environments | More people can work with BCIs despite their disability. In working environments quite advanced experiments to utilise BCI in controlling systems | BCIs are very common. People can choose whether they want to use BCIs or other controlling systems for e.g. "writing things down" |
| **Quantum Computing (QC)** | | | | |
| Simulation of online world through "extremely fast" computing | Enables to understand human consciousness in relation to development of Artificial Intelligence | under research | under development | humanoid like co-workers |
| Teleportation | Enables people to move from one place to another in no time | under discussion | under research | under more research? |
| **Design Approach (DA)** | | | | |
| Life-Based design | Takes into account individual preferences in designing of work place | Currently not used widely in design and development of personal work environment | Takes into account not only physical but also psychological and social context of worker | Life Course, Context and situation of Individual is holistically taken into account in work context |
| Age Management | Takes into account age as an important factor in designing of work place and tasks | Approach more and more widely known in current work contexts | Mainstream approach to fit different people to their work and tasks. Has been assimilated to the more holistic life course management approach | Age is not any more relevant factor in working environments for people under 20 years old |

## 5. NEEDS FOR AGEING AT WORK

- **Ageing per se is associated with decline in physical and mental capacities of individuals. Other non-ability traits, such as personality, emotion and affect, do change as individual age, influencing motivation, values and attitudes**
- **Physical work capacities decline as individual age. Physical work load should decrease according to the normal age decline in physical capacity (20-25%) during ages 45-60.**
- **Mental capacities change as individuals age, with some mental function decreasing—fluid intellectual abilities—(i.e., working memory, abstract reasoning, attention, and processing of novel information) and other improving—crystallized intellectual abilities—general knowledge, extent of vocabulary, and verbal comprehension—and use of language, ability to regulated emotions, ability to process complex problems in insecure situations.**
- **Overall job performance of older workers does not show significant differences with respect to job performance of younger workers.**
- **Non-ability traits, such as personality, emotion, affect, are re-organized or exchanged as individuals age, giving rise to qualitatively different constellations of motives, values and attitudes. In particular: (1) Extroversion, neuroticism and openness all show mean declines so that older adults can be expected, on average, to be less active, less anxious, and less open to new experiences than younger adult, (2) Conscientiousness and agreeableness do increase over a life span, (3) Increased preferences for physical security, job security, salary, and opportunities for skill utilization may accompany ageing, (4) Negative affect declines with age, (5) Positive affect remains relatively stable through late midlife, (6) Adults experience positive emotions through age sixty, but older adults tend to report fewer negative emotions than younger adults.**
- **As individuals move from midlife to old age they tend to show a diminution of "instrumental" values (e.g., financial security) but an increased orientation toward "terminal" values (such as desire to make the world at peace).**
- **Collectively ageing is associated with emergence of generative motives, greater use of emotion control strategies and preference for transactions that supports positive affect, self-concept and identity.**
- **Organizational forms for goldenworkers range from (1) large traditional organizations with specialized knowledge around human resources and with resources to implement ageing policies, to (2) small and medium enterprises that have less specialized knowledge and (3) mature entrepreneurs who start a business or organization after the main period of their work life. ICT for goldenworkers should take into account these different contexts.**
- **Work functions that ICT needs to interact with are (1) learning, (2) communication, (3) coordination, (4) productivity, (5), collaboration, and (6) knowledge management**

The previous sections have highlighted the challenges facing the European society caused by demographic shifts. An important consequence of this shift is the need to reinvent the **social security system** that has been the foundation of the European social system since World War II. Part of this reinvention relies on keeping a higher percentage of the population in the workforce as they age.

**Demographic trends** in Europe indicate diminishing dependency ratios. The economic consequences can only be controlled through creating more jobs to maintain people at work longer. People are living longer with longer healthier lives (although the last years' of a person's life have not changed from a **health** perspective) making the option of longer working lives more feasible than before.

**Education** is highly correlated with health and employment. Forecasts indicate increasing demand for high qualification jobs and a decrease in low qualification ones. Education in the early years of a person's life but also life long learning appear as critical aspects to ageing at work.

People themselves are adapting to a changing environment with more rapid obsolescence of skills. Traditional life models are being replaced with more flexible across life and stages. Mature entrepreneurs are the choice of a large number of ageing workers to stay or rejoin the labour force.

**Policy making** is also an important factor in keeping people at work. Retirement policies affect the cost and benefits of remaining at work. Policy making also affects ageing at work supporting the acquisition of knowledge and skills, especially of those groups of the population at risk mainly low educated people. Policy making supports ageing at work through actions that encourage innovation at various levels. There will be innovations around social policies such as flexisecurity, but technology and ICT in particular will develop products and services to adapt work environments to ageing workers.

Still another important aspect of ageing at work is adapting the **work environment** to the needs of an ageing population. This section analyses physical and work attitudes as people age and the structure of work environments to adapt to these changing needs.

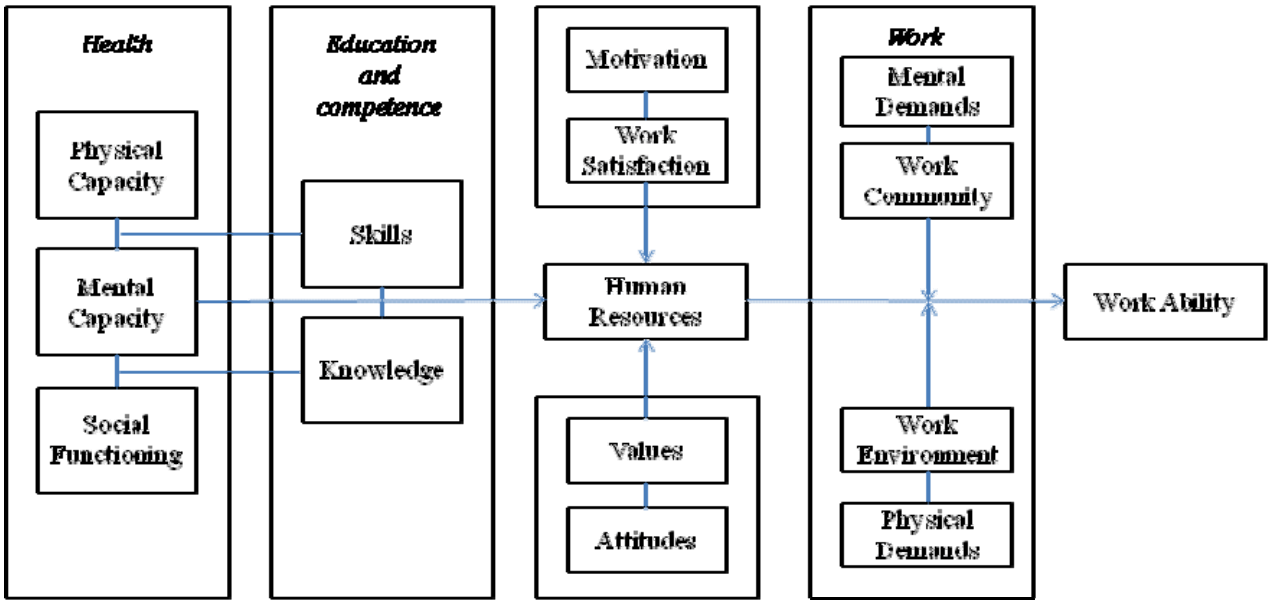
### 5.1 Work Ability Framework

In Europe, the pioneering longitudinal studies conducted at the Finnish Institute of Occupational and Health (e.g., see Illmarinen *et al.*, 1991; Illmarinen, 1999) have led to the development of the concept of **work ability**. Authors of these studies have concluded that the degree to which an individual can be considered able to work (i.e. 'work ability') is a process of **individual human resources in relation to work demands** (including organizational level characteristics, such as team composition and organizational climate and culture). This concept emerged as the result of 11 years follow up of 6'500 blue and white collars and associated research (see Illmarinen, 1999; Tuomi, 1997).

**Human resources** can be defined as the **set of resources owned by an individual at a given point in time**. Human resources are function of individual level factors, typically **physical capacity**, **mental capacity**, **social functioning** as well as **education** and **competence**. Non ability traits, such as motivational structure, values and attitudes combine with other individual level attributes to collectively shape human resources. **Environmental external** conditions (i.e. factors associated with the work environment and the nature of the job) mediate the degree to which human resources determines work ability of individuals (See Figure 13). Research in Industrial gerontology (Stagner, 1985; Sterns, Alexander, Barrett, & Schwartz, 1987; Sterns & Doverspike, 1989) has come to a similar conclusion, and suggested that the older worker should be investigated in relation to the work context (**Figure 38**).

The framework suggests that three individual level variables do influence individual human resources, two - health and education and competence – representing **individual ability traits** and one – motivation, values and attitudes – representing **non-ability traits**. Characteristics associated with the broad notion of work – including job features, work community and environment and physical demands – do define work ability. We use this framework for reviewing the relevant literature for each one of the individual variables.

**Figure 38: Work ability conceptual framework**




The figure emphasize that individual work ability is a process of human resources in relation to work. Human resources depends on: i) Health and functional capacities (typically physical and mental), ii) Education and competence (skills and knowledge), iii) Values and attitudes, iv) Motivation. External factors include v) work demands (physical and mental), vi) work community and management and vii) work environment.

## 5.2 Abilities and Attitudes of Ageing Workers

### 5.2.1 Physical and Mental Work Capacities

**Physical work capacities** (i.e. capacities to carry out physical work) decline as individuals age. These changes mainly affect the **cardiovascular and musculoskeletal systems**, body structure and some important sensory systems (see Ilmarinen, 2011). The maximal oxygen consumption (Vo2 max) [l/min], is typically taken as an indicator of the ability of older workers to conduct physically demanding tasks.

International recommendations say that physical work should not require more than 50% Vo2 max of an individual. Research in gerontology has furthermore shown that while physical work capacity tend to decline with ageing, huge individual differences – typically associated with the extent to which individuals train or not – are observed.[xviii]

Physical capacity tends to decrease – on average – between 20-25% during the age 45-65 years (Ilmarinen, 1992). Research on the degeneration of the musculoskeletal system in relationship to professional occupation has also shown that while a decline in the capacity of this system is associated with ageing, the nature of today's job does not prevent a decline in musculoskeletal function.

**Living habits** do accelerate or slow down changes in physiological functioning of ageing individuals. For instance, physical exercise keep physical capacity nearly unchanged between 46-65 years and a lack of appropriate exercise can make a 45 years old worker less fit than his-her active colleague aged 65.

Illmarinen (2011) after reviewing existing literature on ageing and decrease in physical capacities in relationships to occupation – has suggested that:

- Physical work load of jobs should be decreased with advancing age[xix]
- **Regular exercise should be encouraged** to keep the cardio-respiratory capacity to at least age related average.

Accordingly, the literature on occupational health broadly agrees on the importance of:

- Making sure ageing workers can maintain a normal age related fitness level.
- That the physical work load decrease according to the normal age decline in

physical capacity (20-25%) during ages 45-60.

Empirical evidence has confirmed in various instances that a **stressful and dangerous workplace** significantly contributes to the deterioration of work capacity. Specific risk factors include dirty and wet workplaces, accident hazards, hot or cold workplaces, and changes in temperature during the workday (ILO, 1995; WHO, 1993). Indeed, Jacobson's (1970) earlier investigation of British factory employees' willingness to retire in relation to physical conditions of the job clearly demonstrates the need to consider the severity of demands placed on older workers by stress factors such as noise, dust, fumes, heat, and humidity. More recently, Mitchell and colleagues (Mitchell, Levine & Pozzebon (1998) have presented data showing that, on the average, **blue-collar workers retire earlier than do white-collar workers**, with those employed in the service industry falling somewhere in between.

Under the umbrella term **mental capacity** falls various cognitive and meta-cognitive characteristics of individuals, such as perception, memory, learning, thinking, the use of language or self concept, self value, perceived competency and control of life.

**Fluid intellectual abilities are most associated with working memory, abstract reasoning, attention, and processing of novel information**

From the point of view of work life the most important changes are related to **weakening of precision and the speed of perception**. However, as the literature has revealed some mental functions may also improve with ageing (Baltes & Baltes, 1990; Schaie, 1994). Examples are control of use of language or the ability to process complex problems in insecure situations. Illmarinen (2011) has proposed that overall, as individuals age, they achieve mental growth, improving wisdom, control of life, ability to comprehend the whole, and often offering strong commitment to work.

In research on adult intellect over the past sixty years or so, scholars have stressed the importance of differentiating between two broad kinds of intellectual abilities across the adult life span: (1) **fluid intellectual abilities** (called "Gf") and (2) **crystallized intellectual abilities** (called "Gc" ) (see Cattell, 1943; 1987; Kanfer & Ackerman, 2004). The importance of this differentiation stems from the recognition that as adults' age, quasi-symmetric changes occurs in these categories of intellectual abilities, i.e. while fluid intellectual abilities tend to decline, crystallized abilities tend to improve.

**Fluid intellectual abilities** are most associated with **working memory, abstract reasoning, attention, and processing of novel information**. These tend to decline with age (Wechsler, 1994), with maximum levels of Gf usually reached in the early twenties (Schaie, 1996). Poffenberger (1942) noted that because workers infrequently work at their capacity limits, these changes should not be taken as a justification for the expectation that job performance will decline. However, as Kanfer and Ackerman (2004) have suggested, these changes may increase the "cognitive cost" of exerting the same quantity of cognitive resources. This suggests that the extent to which decline in cognitive capabilities may be affect job performance should be understood in relationship to job demands and job knowledge. For example, older workers may have more difficulties in keep working in fast changing industries than in slow changing ones.

**Crystallized intellectual abilities** (Gc) represent broad aspects of educational or experiential knowledge (Cattell, 1987). Gc is associated with **general knowledge, extent of vocabulary, and verbal comprehension**. In contrast to Gf, measures of Gc tend to show increasing levels of performance well into middle age and beyond (Kanfer & Ackerman, 2004).

Because only some capacities decline while others improve, scholars from various disciplines have theorized that **overall job performance of older workers can be expected to be as productive as that one of younger workers** (Baltes & Baltes, 1990; Kanfer & Ackerman, 2004). This has been confirmed empirically, with most reviews and meta analysis in scientific literature reporting little consistent relationship between ageing and job performance (McEvoy & Cascio, 1989; Rhodes, 1983; Salthouse & Maurer, 1996; Waldman & Avolio, 1986; Warr, 1994).

### 5.2.2 Education and Competence

Education and competence are not related with ageing per se, but rather with **path dependent factors**, such as **career development trajectories** and opportunities as well as non-work factors, such as **family**

**conditions**, **friends** and **community**. Several factors may concur determining education level and competence, including individuals' motivation for learning, personality traits as well as organizational culture, climate, etc.

### 5.2.3 MOTIVATION AND VALUES

Mounting evidence exists that as adult age a reorganization in the structure of non-ability traits (such as personality, emotion, affect) occurs, giving rise to a qualitatively different constellation of motives.

Motives can be defined as dispositions to find a general class of incentives more attractive (Veroff, Reuman, & Feld, 1984). The field of psychology offers several insights concerning motive re-organization as individuals age. According to Carstensen (1998) as individuals age, motives changes because of **reorganization of goals around affect**. Because of shifts in individual's time orientation from "lived from birth" to "life until death" (Naugarten, 1968) new different emotion regulation strategies (a.g. avoid conflict, suppression) are developed and used by older adult. While adolescents and young adult tend to seek social interactions primarily for their informational value (and development of future opportunities) older adult seek social interactions primarily to obtaining **affective reward** (i.e., emotional satisfaction).

Kanfer & Ackerman (2004) have proposed that age-related changes in person characteristics influence work motivation through their impact on the psychological variables involved in information processing.

These variables include personality traits, vocational interests, affect and emotion and self-concept.

Overall trait theorists tend to agree that:

- there are mean, age related changes in traits level across the life span (see Jones & Meredith, 1996),
- extroversion, neuroticism and openness all show mean declines so that older adults can be expected, on average, to be less active, less anxious, and less open to new experiences than younger adult,
- conscientiousness and agreeableness do increase over a life span (e.g., see Warr, Miles & Platts, 2001)
- that personality traits tend to stabilize by the time an individual is between 20 and 30 years (e.g., McRae & Costa, 1990).

However, more recent research suggests that while personality traits are mostly consistent in adulthood, they nonetheless retain a dynamic quality (Roberts & Del Vecchio, 2000).

**Vocational interests** represent preferences with respect to the attractiveness of various classes of work/job attributes. Studies focus on changes in vocational interests across a life spam are limited and dated (Kanfer & Ackerman, 2004). More recent studies on age and job preferences (see Warr, 1997, 2001) suggests that age is likely to be positively associated with increased preferences for physical security, job security, salary, and opportunities for skill utilization through late midlife. In contrast age tend to be related to preferences for job variety, feedback, and provision of external goal assignment. It is furthermore suggested that age-related preferences in job features may influence motivation through their impact on the valence or anticipated utility of performance (Warr, 2001).

Research in affect and emotions (e.g., see Gross, Carstensen, Pasupathi, Tsai, Skorpen, & Hsu, 1997; Charles, Reynolds & Gatz's, 2001; Carstenses et al., 2000) suggest that:

- negative affect declines with age
- positive affect remains relatively stable through late midlife
- both younger and older adults experience positive emotions through age sixty, but that older adults reports fewer negative emotions than younger adults.

Such findings suggest that overall improvements in emotional functioning (i.e., use of emotion control strategies) are associated with ageing.

Research in self-concept suggests that individuals are sensitive into changes in their ability and that they will act so as to protect their overarching self-concept. With the transition from young adulthood into middle age and beyond, individuals that see themselves as possessing lower abilities for Gf-related tasks and higher levels of Gc related-knowledge may behave so as to **protect self concept, introducing strategies such as avoidance** (e.g. aversion to Gf-related activities) or compensation (e.g. increased interests in demonstrating Gc-related knowledge). Kanfer and Ackerman (2004) have suggested that protecting self-concept may be one of the leading determinants of middle-aged and older adults' avoidance of some kind of career

development activities (e.g., see Maurer, 2001). When adults fall victim of a "**performance orientation**" – they strategies so as to avoid situations that are likely to place them at a disadvantage in comparison to younger workers. A classical example is the introduction of new technologies.

In contrast, such workers may be much more willing to sign up for career development activities that do not demand Gf-type abilities. Examples are developing management potential or interpersonal skills. However strong evidence indicates that older workers do more **poorly in employee training** (Kubeck Delp, Haslett, & McDaniel, 1996).

Finally research on values (e.g., see Allport, Vernon & Lindzey, 1951; Ryff & Baltes, 1976) suggests that as individuals move from midlife to old age they tend to show a **diminution of "instrumental" values** (e.g., financial security) but an increased orientation toward **"terminal" values** (such as desire to make the world at peace). Kanfer & Ackerman (2004) note that such a suggestion is consistent with other personality and affective life-span theories that stress recalibration of a lifetime perspective and an increase in generativity motives during midlife.

Overall, the literature on motivation and values as well as mental capabilities suggests that the characterization of adult ageing as a process of decline is incomplete. Rather the process of ageing is associated with several changes, involving multiple mechanisms (such as re-organization or exchange) and complex interdependencies (see Kanfer & Ackerman, 2004). Our literature review offers the following general suggestions:

- Decline in fluid intelligence (Gf) occurs in the context of growth in crystallized intellectual abilities (Gc).
- While some personality traits are accompanied by a mean level decline (e.g., openness to experience) other are characterized by a mean level increase (coscientousness).
- Consistent with these findings a growing body of literature suggests a reorganization of personality and affect around midlife. These changes may be characterized by:
- Emergence of generative motives
- Greater use of emotion control strategies
- Preference for transactions that supports positive affect, self-concept and identity.

While these aspects may different considerably across individuals pertaining to a same cohort, and while very little is known on the age at which such changes are expected to occur, we suggest the design of initiatives aimed at managing older workers should **keep in consideration these important changes**.

### 5.2.4 Work Ability and Employability

Several scholars have recognized that dynamics needed to fit human resources to the new work demands have often been left underdeveloped and have therefore caused the **displacement of many workers over the age of 55** from the labour market. It has often been incorrectly argued that their competency is no longer sufficient and their experiences no longer valid. Illmarinen (2011) has argued that the major reason has often been the uncontrolled changes that have occurred in work and the lack of adjustments urgently needed for fitting their resources to the new work demands.

Latest experiences in occupational health, industrial gerontology and social studies show that there are two main processes that affect the employment rate of ageing workers, one being the promotion of work ability, and the other being the development of employability. The concept of employability is still developing but can be considered to include powerful characteristics and infrastructures needed at the level of society for better employment of all age groups. It includes **employment, education and exit policies**, a large variety of social and health services, and also, for example, the **general prevention of age discrimination**.

**Older workers tend to demonstrate considerable interest in training**

In general the notion of employability is concerned with the shedding light on the nature of the barriers that mediate the relationship between workability and employability. Several barriers exists that affect employers and employees in relationship to ageing. There are ageist attitudes among employers, particularly over the ability of older workers to adapt to change. In addition employment opportunities of older workers may be limited because their skills have become devalued or they receive little help in finding new jobs. Transition from work to

retirement and back, may require keeping older workers "**job ready**" (Rix, 2011). In addition efforts are required at the level of the work place. available employment opportunities may be unattractive because of poor working conditions or unsuitable and inflexible working-time arrangements. Understanding these barriers is important in forecasting the effectiveness of pension policies. In fact, as already noted, pension reforms that have improved incentives for older workers may be less effective in encouraging later retirement if there are still substantial barriers to work on the demand-side.

**Un-retirement**, i.e. a return from retirement to the labour force, is problematic for several reasons, the principal being that leaving a job at old ages weakens labour force attachment and the longer workers remain out of the job the less likely they are to return. Nevertheless research has revealed that a **substantial percentage of workers to re-enter the workforce** for any number of reasons. Examples are the money, the social contacts, the work itself, or to get out of the house. Several studies suggest that as many as one quarter of older labour force "un-retire" (Maestas, 2007; Ruhm, 1990). In fact, some of them appear to have planned to re-enter before retiring the first place (Maestas, 2007).

### 5.2.5 KEEPING THE WORKERS JOB READY

Under this label are considered all the **continuous training** interventions necessary to keep older workers attractive for employment. Declining job tenure for some age group, frequent job turnover and technological change emphasize the need for continuous training and retaining, or life-long education (Rix, 2011). This is particularly crucial in the case of older workers, whose formal training may have taken place decades ago. Charness and Zaia (2006) suggest that rapid technological developments and an accelerating pace of change in the workplace require repeated training not only in new systems but in new ways to do things. Research has revealed that **older workers tend to demonstrate considerable interest in training** (see Rix, 2011) but has also revealed that those workers do not necessarily get as much training as wanted or needed. Not only they tend to receive less training, but their training is also likely to be informal when compared to the training received by younger workers (Frazis et al., 1998).

Empirical evidence indicates that **older workers can learn well into age**, but learning new skills may be more taxing from them (due to physiological and psychological changes related to ageing). Accordingly older workers may take longer to acquire and master new skills (e.g., see Charness & Czaja, 2006) and this has implications for the development, implementation and cost of training programs (Rix, 2011).

Finally because the majority of job training is typically provided by the employers themselves, workers who require job training to get a job (whether they are displaced workers or seeking to return the work force) have relatively few options (unless they are able to pay for the training themselves).

### 5.2.6 WORKPLACE MODIFICATION AND FLEXIBILITY

There is little evidence, outside the field of healthcare, that many employers have done much to accommodate older workers, even if countries such as Finland are pioneering in this area (Illmarinen, 2008). According to Illmarinen (2008) it is critical for **older workers retention to modify the work place** so as to ensure a safe, clean, properly lit and ergonomically correct work environment. On the whole, workplace modifications may be best handled on a case by case basis (Rix, 2011).

**Several countries have had public-information campaigns to tackle ageism in the workplace**

It is typically acknowledged that **more flexible work arrangements**, including opportunities to phase into full time retirement from full time work, might encourage employees to push back the date of retirement. Many older workers declare that they would be interested in shifting to part time work (AARP, 2004) or phasing into retirement (Mulvey & Nyce, 2005).

Despite this, older workers who do manage to achieve more access to workplace flexibility seem to have to "pay" for it (Rix, 2011). Haider and Loughran (2001) found that **workers who remain in the labour force after age 65 are better educated, healthier, and wealthier** than their non working peers, but had relatively low wages – perhaps as the research speculated because they had to trade wages for flexibility. On the whole, most workers still lack access to workplace flexibility and a very few can telecommute (Hardy, 2008). While formal phase

retirement programs are rare, informal and ad-hoc arrangements that facilitate an easing into retirement are common (see Rix, 2011).

### 5.2.7 AGE DISCRIMINATION

**Age discrimination** in particular is receiving increasing attention in research in organizational behaviour and ageing in general, even if it represents a old issue.

In the US the Age Discrimination in Employment Act (ADEA) of 1967, amended in 1978 and 1986, protects workers over the age of 40. The act was initially issued in response to the recognition of an increasing tendency to discriminate older workers. In 1965, the Secretary of Labour found that **half of all private job openings were barred to applicants over 55** and a quarter closed to applicants over 45 (Edelman & Siegler, 1978). According to the ADEA of 1986, it is illegal to discriminate against a worker over 40 on the basis of age, age related stereotypes, or assumptions concerning abilities, physical status, or performance. Many European countries took steps much more recently, in many cases prompted by a European Union directive in 2000 requiring them to do so by 2006 (OECD, 2011).

In addition, several countries have had **public-information** campaigns to tackle **ageism in the workplace** (OECD, 2011). Examples include Australia, Finland, France, the Netherlands, Norway and the United Kingdom. Employers are not just being told that they cannot discriminate against older workers through the law. They are also provided with tools and information for managing an older workforce. In some instances, there has been a strong emphasis on managing age diversity in the workplace to avoid stigmatising older workers.

Despite these initiatives, there is evidence that age discrimination, in the form or stereotypical ideas and assumptions, does exist.

The OECD (2011) reports that **prevalence of perceived age discrimination** has declined in some countries during the period 1995-2005. Among the countries that have taken a strong public stance against age discrimination (through legislation or public-information campaigns or both), there were fewer reports of ageism at work in Finland and the United Kingdom in 2005 than earlier, but the Netherlands recorded an increase. Similarly, there have been significant declines in perceived age discrimination in Spain and Portugal despite the fact that government action in the period in question was limited.

Research indicates that **stereotypical attitudes** are often reflected in the performance appraisal of older workers (Robertson & Tracy, 1998), and data from the US suggest that there is an age related decline in earnings (Wanner & McDonald, 1983).

Two studies performed in the 1990s (Institute for Manpower Studies, 1990; Lynn and Glover, 1998) of manager attitudes to senior workers suggested that **managers associated certain characteristics with age**. These are mainly negative (e.g., lack of flexibility, lack of mobility, non adaptability) even if some positive characteristics exists (e.g., responsibility and maturity, commitment to work, experience).

A recent study performed by Remery et al. (2001) found out that managers tend to associate an increase in the average age of their workforce with higher labour costs, not 'direct' costs (e.g., salaries), but also to 'indirect' costs related to absenteeism or resistance to change.

Research in the United Kingdom indicates that, where older workers are being recruited into the labour force, it tends to be predominantly into **part-time, low skill, low pay, low responsibility, and repetitive jobs** (Wanner & McDonald, 1983). Some researchers have pointed out that, although discrimination against older workers operates across all socioeconomic groups, its greatest impact is on lower skilled groups (Walker &Taylor, 1993).

Because of various forms of discrimination, workers tend to be disadvantaged when they are in minority and when compared with younger employees. While age is not generally associated with lower performance ratings (e.g., see Avolio, Waldman & McDaniel, 1990) there is evidence that **employees who are older than the age norm for their career stage receive lower performance ratings** (Lawrence, 1998), as do employees who are older than their work group (Cleveland & Shore, 1992). In a similar vein research on promotion has shown a decrease in upward mobility with age (Cox & Nkomo, 1992) due in part to age norms associated with career progression (Lawrence, 1998), and especially likely when the employee is older than his or her manager (Shore, Cleveland & Goldberg, 2003) or work group (Cleveland & Shore, 1992).

Evidence that some form of discrimination exists as **embedded in "myths" and ideologies** is further revealed by the findings

from research on the productivity of the older worker, specifically work attitude and work behaviour. Peterson & Coberly (1988) (cited in Robertson & Tracy, 1998[xx]) highlight five important "myths" that are related, either directly or indirectly, to age-related changes among older workers (i.e., declines) in health:

- **increased age results in generally poor health**, loss of physical energy, and increased illness, leading to the assumption that older workers have a decreased capability to perform work tasks, a loss of stamina, and higher rates of absenteeism;
- **increased age results in higher accident rates**, more lost workdays, and increased insurance and medical costs, leading to the assumption that older workers are more expensive to a company, increase company risks, and are a danger to themselves and their co-workers;
- **increased age results in lowered productivity** because of slower actions, greater absence, and less commitment to the employer, leading to the assumption that older people cannot compete with younger workers;
- **increased age results in a rigidity of behaviour**, an inability to learn new skills, and a rejection of innovative changes, leading to the assumption that older workers are not good candidates for retraining and challenging assignments that require learning new skills and work managements; and
- **increased age reduces the potential value of retraining**, job development, and skill upgrading, leading to the assumption that older workers are not worth the investment of company resources (what has been called the "human capital argument").

Robertson and Tracy (1986) review a large body of literature at the nexus between ageing, health and work, coming to the conclusion that socially constructed perceptions of older workers, including expectation on their behaviour and productivity, are not supported by empirical investigation. For example, they report that – contrary to general managerial belief - **older workers are generally less likely to incur accidents than their younger counterparts**, or that there is no evidence of a relationship between age and absence from work.

They conclude that significant opportunities exist at the level of corporate policy for **increasing the work ability of older workers** for example by adapting work tasks, work conditions and work arrangements. They go to suggest that because age is not a good predictor of the work ability of individual workers, and that measures discrimination may accompany age-based policies, human resources policies – recruitment, promotion, training, and retirement – should be function-based – i.e. based on an assessment of the characteristics of individual workers.

### 5.2.8 JOBS FOR YOUNGER AND OLDER WORKERS

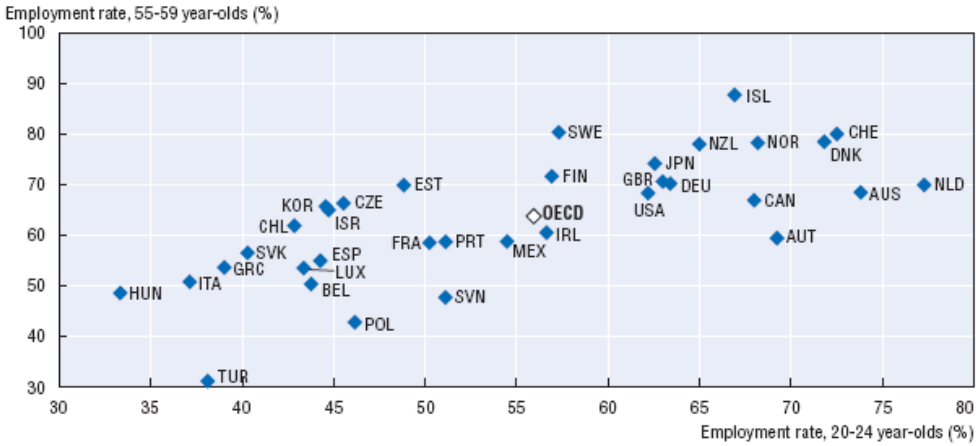
A typical preoccupation of policy makers with respect to policies aimed at increasing the participation rate of older workers in the labour force, is that it may affect unemployment of youngsters, depriving them of jobs.

Economists call this the "lump-of-labour fallacy". According to a recent report by the

OECD (2011) the idea that public policy can re-shuffle a fixed number of jobs between workers of different ages is simply not true.

**Figure 39** below, compares employment rates of older (aged 55-59) and younger people (aged 20-24). The relationship between the two is positive and highly significant in statistical terms.

**Figure 39: Employment Rates—Younger and Older workers**




*Note:* Regression line shown (heteroskedasticity-adjusted standard errors in parentheses) is employment rate of 55-59 year-olds = 36.84 (6.671) + 0.4565 (0.1402) × employment rate of 20-24 years. $R^2$ of the regression is 0.2381.

*Source:* OECD calculations using Eurostat data.

StatLink http://dx.doi.org/10.1787/888932370607

*Percentage of 55-59 years old and percentage 20-24 year old in employment 2009. Source: adapted from OECD (2011)*

## 5.3 ORGANIZATION MODELS

One of the components of work in the work ability model (section 5.2) is **work environment**. This variable is important because different types of organizations have access and provide different management and ICT tools.

Organizations and markets are two extreme forms of structuring work relationships (Ouchi 1979; Thompson 1967). Both are relevant to the issue of ageing at work. Some of the people in this population maintain their positions in **large organizations**, whether large companies or in the public sector. These organizations will have to adapt to the emerging needs of ageing and some of them are starting to do so. Later retirement ages and the need to keep a motivated workforce will force these organizations to design policies for this segment. Another segment of ageing workers remain or join **small and medium enterprises** that are the largest employment generators in Europe (section 3.4). This type of organizations is less likely to adopt policies specific to ageing workers and public intervention (through legislation or dedicated programs) may be required. Yet, another segment of ageing workers become **entrepreneurs** and start their own business after leaving the workforce. Section 3.4 outlined how mature entrepreneurs are a preferred route to remain in the workforce.

To analyze work functions and the role of ICT, we work with three organizational stereotypes (**Figure 40**).

**Figure 40: Organizational models**

(1) Large organization: For profit and public organizations that have devoted human resources departments. While the level of sensitivity to ageing workers of these companies varies from ageing as a problem to ageing as an opportunity to ageing as equal opportunity, these **organizations have the resources and access to knowledge and technology** to adapt work functions to the needs of goldenworkers. Human resources departments can choose to put in place management processes and systems (often based on ICT) to incorporate ageing into the career management of employees.

(2) Small and Medium Enterprises (SME): Smaller organizations have limited access to resources and knowledge to adapt work environments to ageing workers. While some of these organizations are at the frontier of management, on average, they have less specialized human resource departments and human resource policies. Adaptation of the work environment to goldenworkers has fewer resources and less access to knowledge. Moreover, the **management team of the SME itself can be goldenworkers**. These people need to have the opportunity to adopt ICT to keep their organizations competitive in the market place. Market forces but also legislation, awareness, and public support for ageing at work are likely to have a higher impact.

(3) Mature entrepreneurs: These are goldenworkers who choose to start their own organization. Ageing people have experience and crystallized intellectual abilities that facilitate **starting new businesses or social organizations** (social entrepreneurs). The challenge that these goldenworkers face in adapting to the working environment evolves around the interacting with stakeholders including accessing customers and communicating their products and services to the market, accessing to human and capital resources, and accessing advisors to run the newly created organization.

### 5.4 WORK FUNCTIONS

Work needs are diverse. They vary across professions, types of organizations, and countries. As we've discussed in section 5.1, the most significant impact of ageing is associated with physical activities where older people are, on average, at a disadvantage. Most of the other cultural stereotypes associated with ageing at work have been consistently proven wrong (Addeco, 2011) and associated with discrimination embedded in society's values.

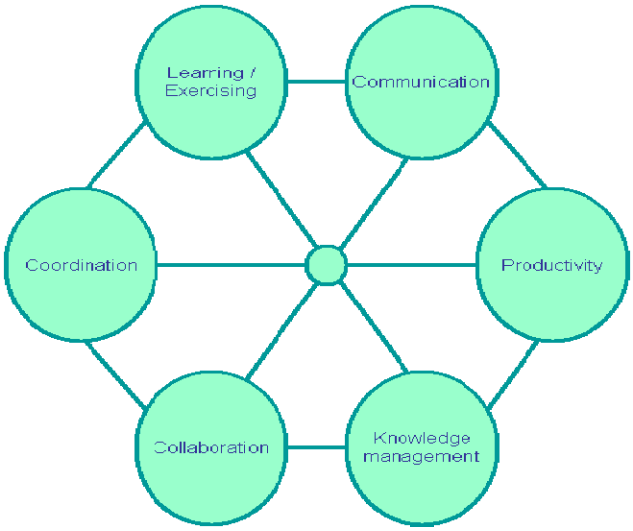
A balanced **professional-private life** for ageing workers shares characteristics with other groups in the population. Ageing workers often require flexibility for family, leisure or health reasons; the need for flexibility is shared with families with young kids who need to adapt to the conditions of their siblings. Those ageing workers with disabilities face challenges at work similar to people with disabilities in other age groups; they need communication and productivity tools that are no different form these other groups.

Ageing at work requires **responding to work demands** much like any other position. The ageing component requires development and adaptation of technology but also legislation, policies, and cultural norms to the needs of this segment of the population.

Work functions will need to be adapted to the **special demands of goldenworkers**: flexibility, gradual retirement, lower cognitive and physical capabilities, disabilities, or health problems, lower working hours, or multiple jobs.

**Figure 41** presents the demands that organizations and markets put on working people. When examining the future of ICT and ageing at work, these functions describe the demands to be analyzed.

**Figure 41: Work functions**




### 5.4.1 LEARNING AND EXERCISING

**Learning is a central aspect of work**. Section 3.4 describes how the level of education is highly correlated with employment across all ages. Knowledge is a rapidly depreciating asset (Levinthal, and March 1993; Levitt, and March 1988), especially in fast moving industries or industries where technology plays an important role. The rapid expansion of ICT across most industries has made ICT literacy an important requirement for work. The digital divide (NPA Report, 2001) impacts across all ages and is most relevant for ageing population with more outdated ICT skills (if any).

ICT skills are just an example of the importance of learning when knowledge and skills evolve rapidly. Similar processes take place in other professions. The only way to counteract the outdating of knowledge and skills is though **life long learning** where education and training are integrated in working life.

Ageing workers face **various limitations**. First, the cultural belief that training pays off with younger people because the returns to learning accrue over a longer work life (Cappelli and Novelli, 2010). The argument is technically correct if the knowledge acquired does not depreciate. However, today's work skills and knowledge quickly becomes obsolete making this argument valid for workers reaching the retirement age and with no plan to rejoin the workforce. Interestingly younger as well as older people share this belief. A second limitation is that **learning is a habit that can quickly be lost**. Life long learning argues for periodic learning episodes not only to update and acquire skills and knowledge, but also to keep this habit in shape. A third limitation is that childhood socialization and network influence the relationship with knowledge and technology in older ages (Sackmann, 1996; Korupp, 2007). Childhoods and networks where knowledge and technology play a minor role decrease the motivation towards learning.

"The best form of employment protection for older workers is to improve their employability" (OECD, 2006). And improving employability requires a **constant attention to learning**. It is no surprise that lifelong learning as emerged as a central theme in previous analysis of policies for ageing workers as well as adapting learning methods to the cognitive and motivational structures of ageing workers (section 3.6).

**Explicit and tacit knowledge** (Nonaka 1994) have different transfer costs. Explicit knowledge is transferable through time and effort. Tacit knowledge has a much higher cost of transfer because it happens through experience, observation, and apprenticeship. Explicit knowledge is often associated with knowledge transfer, while tacit knowledge has a larger component of skills and practice.

Ageing people also face decreasing physical and mental abilities (section 5.2). The speed at which these abilities depreciate depends partly on constantly training them. There are numerous examples of people over seventy who accomplish important physical achievements and contribute intellectually to their organizations. The importance of **exercising** has led to recent efforts to formally address this issue not only in the academic world but also in the entrepreneurial world with start up

companies being founded in this space. Physical and mental exercising is not only associated with better quality of life, but also with sharper abilities that facilitate learning and employability. The work-ability model (section 5.2) identifies these two abilities as part of physical capacity and as important contributors to work ability of goldenworkers through skills and knowledge (education and competence) (**Figure 38**).

Therefore learning has various dimensions relevant to goldenworkers:

- Transfer of explicit knowledge for up-to-date valuable knowledge
- Transfer of tacit knowledge for up-to-date valuable skills
- Physical exercise to maintain physical abilities
- Mental exercise to maintain mental abilities

Delivering these various dimensions of learning differs across the three typologies of organizational models: mature entrepreneurs, SMEs, and large organizations.

Advanced large organizations will incorporate life long learning into their **career management process** including inter-generational transfer of tacit knowledge and equal opportunity. These organizations already have gyms or give incentives to their employees to exercise. ICT will play an important role in delivering some of these types of learning. Less advanced large organizations will follow best practices of leading companies. The challenge will be to make these practices available across different parts of Europe.

**Communication is the process of transferring information**

SMEs face a different challenge in terms of learning. Resourceful SMEs can start incorporating learning into their HR policies and use their **learning network** to be up-to-date on knowledge and skills relevant to keep being competitive. Presently, these networks are physical in that SME managers and employees obtain most of their learning of knowledge through face-to-face interaction. ICT can extend these networks beyond the local community. Learning at SMEs depends to a large extent to having access to **learning institutions** that can provide the knowledge and skills that are not available internally.

Mature entrepreneurs face similar challenges as SMEs in terms of accessing relevant learning for **maintaining their competitive advantage** in the market. Yet, these goldenworkers face the additional learning challenge of acquiring the knowledge required to run a business or a social enterprise.

### 5.4.2 COMMUNICATION

**Communication is the process of transferring information**. Organizations have been fruitfully described as information processing systems (Galbraith 1973; Tushman, and Nadler 1978; Kleinbaum, Stuart, and Tushman 2008). The success of organizations relies on **moving information fast** through the organizational structure and the ability to combine different types of knowledge. As organizations have increased in complexity the demands on communication have raised accordingly. ICT has expanded tremendously the possibilities of communication across space and time and it is likely to improve this function even more in the future.

Communication is fundamental to the other work functions. Learning possibilities will expand as communication alternatives expand. Coordination depends on having communicating information. Similarly, collaboration among team members depends on how they can communicate. Productivity depends not only on knowledge, skills, and access to productivity tools but also on having the right information at the right time in the work place. Finally, knowledge management is a repository that asynchronous communication facilitates.

Communication alternatives vary across **space and time**. The most straight-forward is face-to-face exchange of information and ICT aimed at reducing space limitations has the objective of replicating as **close as possible face-to-face communication**.

**Asynchronous communication** (the old fashioned letter that communicated information without the need of having simultaneous presence) has also expanded through ICT applications. E-mail is the most well-known example, but ICT tools allow for people to exchange information without being simultaneously in the conversation. Project management software, ERP, CRM, etc. are based on asynchronous communication.

Communication technology has also redefined structures from the traditional **one-to-one or one-to-many** (radio, press, etc.) to **many-to-many** (forums) or **many-to-one** (crowd-sourcing).

This function varies across the three organizational models. Large organizations with dispersed work force often across countries with specialized knowledge that needs to be integrated have important **internal communication needs**. Dispersed workforce requires simultaneous communication that is as close to face-to-face as possible. Progress in this technology such as teleconferencing, web conferencing and webinars has provided new management alternatives to companies. Asynchronous communication facilitates management functions not available before. Cloud computing allows sharing and collaborating information, or knowledge management is based on ICT progress and the lowering of information storage costs.

SMEs' communication needs are distinct from large organizations. Internal synchronous communication is not as demanding but advances in this field provide them **access to new markets** and **new ways to work with customers**. Asynchronous communication is not as demanding internally (although these organizations have productivity gains from adopting some of these technologies); however it gives these companies important gains when used externally to work with customers, access partners across the world, and even co-creation through crowd-sourcing.

Mature entrepreneurs benefit from better communication mostly through **access to remote resources**. As communication technology reduces the cost of accessing the talent not available locally, mature entrepreneurs expand the pool of resources they can rely on to start their organizations. Communication allows them to access capital and financial suppliers across the world, join global communities where they can have the latest knowledge available, and they can look for customers worldwide. For instance, better synchronous communication can make long distance teaching possible and have a goldenworker teach a class of her specialty to remote locations.

### 5.4.3 COORDINATION

Organizations are the **coordinated actions of a group of people with the purpose of achieving an agreed objective** (Feldman, and Rafaeli 2002; Bossidy, and Charan 2002). Coordination brings together **dispersed knowledge and information** through communication. This function is intimately related to controlling that activities are performed and results achieved. The combination of coordination and control as two sides of the same coin has dominated organizational research since inception (Anthony 1965; Simons 2000).

As previous functions, coordination has two aspects an internal and an external. Internally, coordination is needed to **combine information, knowledge, skills, and resources**. For instance, workers who require flexibility either because they are young parents or goldenworkers who want a more balanced life will need to coordinate the provision of their time with other participants in the organization. This apparently simple problem of human logistics can be an significant challenge when combining different availabilities from a large group of workers. Externally, coordination is the force that brings together supply and demand functions. Markets only work if suppliers and customers coordinate. This external side is relevant to all markets. For instance, labour markets where people looking for jobs match organizations offering them benefit from better coordination mechanisms bringing together larger number of players with more relevant information.

Coordination mechanisms are associated in the management literature with the concept of **routines** (Knott 2003; Zollo, and Winter 2002) and their evolution through **dynamic capabilities** (Zollo et al. 2002). Routines codify processes such that coordination happens through systems that embed this knowledge rather than informal coordination.

Large organizations have **complex coordination challenges**. Some of these challenges have been presented when describing the communication function. In addition, ICT can facilitate coordination through information exchange. For instance, availability of part time employees who need flexibility at short notice can be enhanced through ICT. Information repositories such as knowledge management or project management software can facilitate flexibility at work.

SMEs benefit from better coordination technologies through their **access to more liquid and larger markets**. External coordination with partners and customers enable these organizations that have traditionally focused in local markets to access new customers and markets.

Mature entrepreneurs benefit from better **external coordination** to better leverage their core competencies but also to have more transparent information in dealing with potential partners and resource suppliers.

### 5.4.4 Collaboration and Teamwork

Collaboration and teamwork takes advantage of communication and coordination and control to facilitate combining of knowledge to create new value propositions or deliver products and services to customers. **Teams are central organizational structures in current organizations** (Clark, and Wheelwright 1995; Von Hippel, Thomke, and Sonnack 1999).

Teams combine people from **different functions** (cross-functional teams), **different locations**, and **different companies** (partnerships). Collaboration tools (like the ones used for this project) enhance productivity through bringing disperse knowledge together, real time and asynchronous coordination, and improving motivation when the various team members work for the best outcome.

Large companies are heavy users of **collaboration tools** to coordinate the activities of their teams. They are also using these tools to implement open innovation ideas (Chesbrough 2005) through crowd-sourcing, beta testing, open software, etc. SMEs use collaboration tools to work with partners and customers, integrating the ideas of team work across companies. Mature entrepreneurs use collaboration tools much in the same way as SMEs to collaborate with partners and customers.

### 5.4.5 Productivity

Productivity is the constant concept that economists use to explain and suggest how to improve the competitiveness of regions and countries. Productivity means **producing more value with fewer resources**. Of course, productivity depends on multiple variables from education to the quality of the infrastructure. As ICT has become more important to executing strategies in organizations, ICT-linked productivity has become also more relevant. **ICT-linked productivity** may also be associated with specific tools to facilitate productivity for goldenworkers. ICT impacts productivity in many ways through improving the various functions identified in this section. Yet there are specific advances in ICT that are related to productivity. User interfaces are one of these technologies. **Friendly interfaces** reduce learning and switching costs and increase motivation. Usability and user friendliness are principles in human-technology interfaces to enhance productivity and integration of ICT into working life.

Productivity also depends on the **quality of software to automate, simplify and reduce human intervention** in organizational processes. ERP, CRM, MRP, and other process automation software are important sources of productivity where technology will make important advances.

**Human-technology interfaces** also have an impact on health in the work place. Better and friendlier interfaces reduce the level of stress, the risk of injury, and job satisfaction. Healthy work environment is not considered in and on itself a work function but rather a consequence of rightly using technology to enhance productivity. Health is one of the main components of productivity. Injuries and work related disabilities have very large consequences on productivity.

Productivity ICT through **process support** and **user interfaces** is linked with work design as part of the work ability framework. ICT enabled organizational functions and not only productivity are important inputs to work design and accordingly to integrating goldenworkers in organizations and markets with the right motivation.

Large organizations have invested heavily over the last decade on **productivity software around process management**. Large ERP implementations have been costly but have provided important productivity gains. Currently, cloud computing is providing new functionalities that enhance the value of enterprise software. User friendliness for interfaces is another field with important advances and benefiting from progress in technology. Current products still rely on finger-input—keyboards and tactile screens, future products will integrate movement sensors, voice recognition, or video processing to integrate information into software.

SMEs have also benefited from **integration of productivity ICT**. Cloud computing has put at the fingertips of these smaller organizations the processing power available to large organizations. Advances in user interface are also facilitating the integration of these companies in global markets.

Mature entrepreneurs can benefit from productivity tools to **simplify, accelerate, and reduce the cost of experimenting with new concepts**. Software is also creating global niche markets that are viable today.

### 5.4.6 Knowledge Management

Knowledge management refers to **improved access to ICT-based knowledge repositories**. This function facilitates access to experiences that have been coded for sharing. It also facilitates accessing expertise that otherwise

would be hard to identify (Van de Ven 1986). Access to information and the ability to interpret this information is at the core of innovation management (Zhou 2007).

Organizations in the western countries but more recently in emerging economies having been moving from competencies based on access to natural resources to **knowledge-based economies**. Knowledge today plays a central role most organizations. There are two main aspects of knowledge:

**Coding** is linked to the concept of explicit knowledge where experiences, concepts, and theories are coded into information that other people can interpret

**Access** is the option to use coded knowledge. Access depends on having the education to be able to interpret the information and on economic or technological barriers that protect this knowledge. Free software is built on the idea of giving free access to software

The original knowledge management systems were books and encyclopaedias where knowledge was coded and accessed. ICT has evolved these primitive systems into systems that code knowledge using words, audio or video that are accessible using different search algorithms. Google is the most used public system to search information on the web.

Large organizations have been **heavy users of knowledge management systems**. They often used closed systems with accessibility restricted to employees where they heavily code the experiences around the world (multinationals). For instance, consulting companies routinely code the projects that they execute to make the knowledge available to the rest of the organization and make them more competitive in bidding for new projects and more productive in executing them. These companies also use knowledge management to identify expertise within the organization and make information about talent within the company much more transparent. Going forward, these systems will gain from better search algorithms, more sophisticated coding of information, and more information available to access.

SMEs use internal knowledge management systems much like large organizations but at a much smaller scale. In contrast, **network-based systems** can provide these organizations with competitive advantages through sharing of information across the globe.

Entrepreneurs are already using **networks for knowledge sharing** such as founders' associations, business angels networks, public initiatives to stimulate and support entrepreneurs, or networks emerging around the idea of mature entrepreneurs. These networks are mostly physical networks that can benefit from scaling through ICT.

## 6. Framework for Analysis

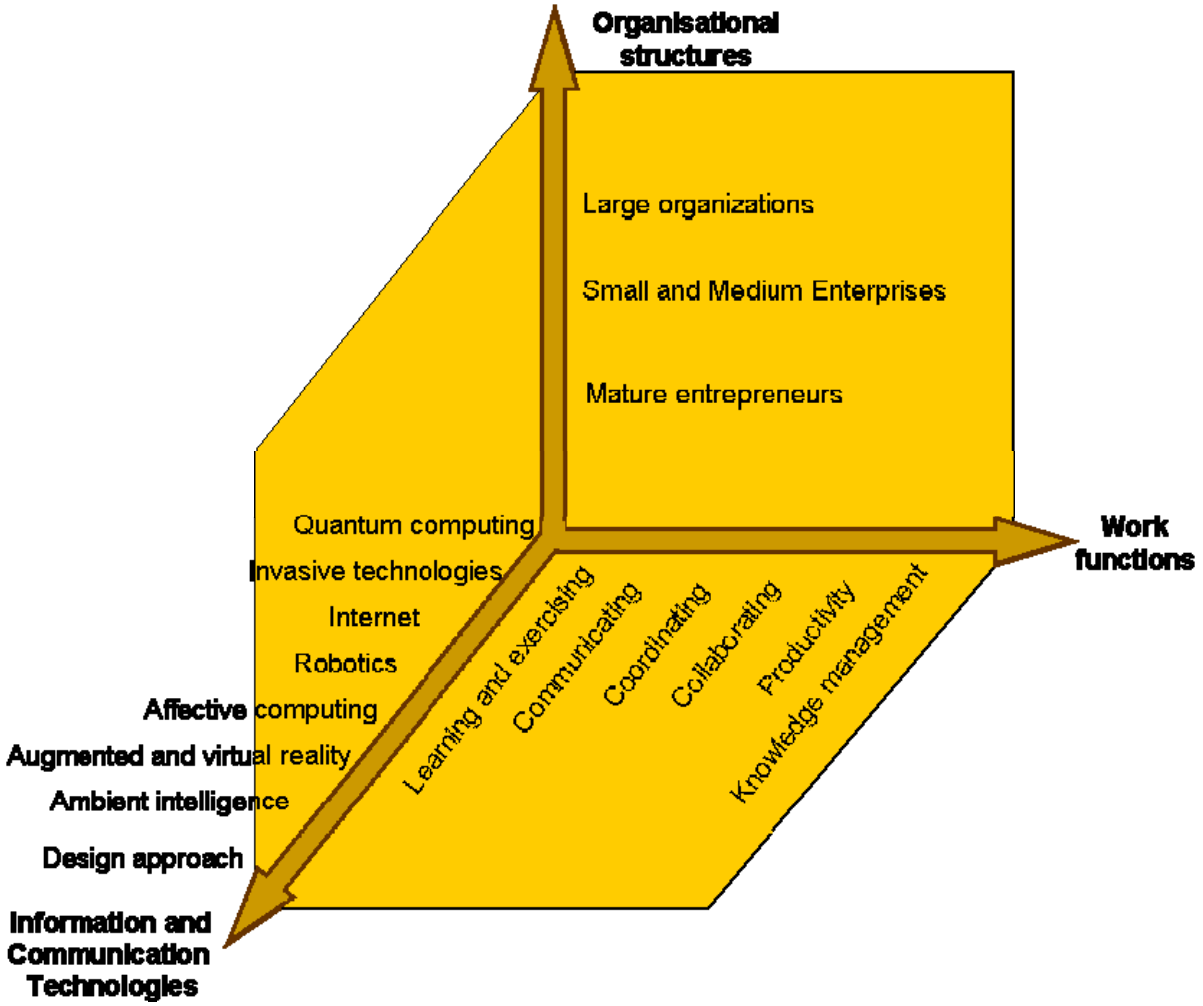
The previous chapters have systematically analyzed social forces and technologies that will shape the future of ageing at work. Demographic trends are putting pressure on existing social security systems as currently designed. They were designed on a pay as you go mentality with a very different demographic pyramid. Advances in health technologies and standard of living are giving higher quality of life years beyond the traditional retirement age. Economic forecasts portray a level of unfunded liabilities that is not sustainable.

Work ability framework links health, education, and values with work environment characteristics. ICT is playing and is expected to play an increasing role in shaping work environments. To shape future discussions on goldenworkers, our analysis has led to three important dimensions to consider:

1. Promising ICT that will shape the future of work environments
2. Different work environments
3. Work functions that ICT can alter

**Figure 42** summarizes the framework for GOLDENWORKERS

**Figure 42: GOLDENWORKERS' framework**



## 7. CONCLUSIONS

This report provides a review of the various aspects that affect ICT and ageing at work with the objective of providing a framework for scenario building and roadmapping of ICT for goldenworkers. The framework is structured around three main axis:

First, information and communication technologies that will shape the future of the field and with significant impact on work environments. These technologies include ambient intelligence with ubiquitous computing allowing personalized, adaptive, anticipatory and embedded technologies for goldenworkers; augmented and virtual reality that combines reality with additional information delivered in a user friendly design to incorporate information into the view of reality; affective computing that captures not only rational criteria but also emotional reactions; robotics that will shape the way in which human-technology interface is designed; future internet that promises to make communication at a distance and across time closer to face-to-face interactions; invasive technologies such as neuroelectronics that will integrate technology into the human body to simplify interaction; and quantum computing that will open an important field around computing.

Second, the project considers three generic work organizations to build scenarios of future goldenworkers and ICT. The first work organization is the traditional large organization whether multinational, large national service companies, or public administration at the national or regional level. These organizations have large internal interactions and resources as well as specialized knowledge to adapt work environments to goldenworkers.

The third dimension is work functions that ICT will influence. These functions include learning and exercising, communicating, coordinating, collaborating, productivity and knowledge management. Learning and exercising address the need for lifelong learning and for keeping capabilities updated.

Communicating will change the way people interact across time and space. These changes will affect the way people coordinate, collaborate, and access knowledge. Finally, ICT will shape the way productivity is enhanced in organizations.

The combination of these three dimensions will help understanding how to develop technologies and policy making to address the challenges that an older population will face. Demographic pressure is making existing social policies as designed today obsolete. Sustainable and fair social systems that have been central to European social model will require redefining the role of goldenworkers.

Through this framework, scenarios will be analyzed with the objective of defining a roadmap of ICT for goldenworkers where new ICT will shape organizations and markets to facilitate more attractive work environments. This state of the art brings together the multi-faced complexity of a central issue for the future of Europe; this is keeping its social model in the midst of an ageing population. The report provides the reader interested in understanding all the aspects of ageing at work a detailed introduction to the various aspects of this phenomenon. To the reader interested in certain aspects, the report provides insights into these aspects.

**Through this framework, scenarios will be analyzed with the objective of defining a roadmap of ICT for goldenworkers where new ICT will shape organizations and markets to facilitate more attractive work environments**

The second work organization is small and medium enterprises where challenges are not so much internal as interacting with external markets. These work environments lack specialized knowledge or resources to adapt to goldenworkers. Moreover, the managers of these organizations will themselves become goldenworkers. The third work organization is the mature entrepreneur who chooses to start her own organization as a way to remain in the workforce.

The purpose of this report is to be an input to the Goldenworkers' project of roadmapping ICT for ageing workers. This roadmap will provide a framework for policy makers, funding agencies, non-profit organizations in this field, companies in the industry, and society broadly to make decisions and evaluate progress. The project is technical at its core in that it is ICT centred. Yet, technology is not socially, politically, or economically neutral. Therefore understanding the socio-economic environment is fundamental to the roadmapping effort. The report not only

examines the macro-forces of the future—demographic pressure, health and education trends, incentives associated with retirement, or social and cultural trends including biases, changing life styles; it also look at the micro-forces of work environments. On this latter issue, the report looks at work ability framework but extends it beyond organizational boundaries to include market forces that shape the environment of small and medium companies and entrepreneurs.

Another implication of the sociology of technology is the diversity within the European Union. The report looks at large trends and conceptual frameworks of work environments, the roadmap will provide a framework of ICT and ageing population to help the decisions of society's actors. Yet, the report and the Goldenworkers' project will not get into the particular adaptation to the various historical and cultural settings that shape a diverse Europe. The interpretation of this report and Goldenworkers will be necessarily shaped by the specific context of each country and community (Gadamer, 1981).

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FORMS: Institute for Operations Research.

[i] Futurage: A Road Map for European Aging Research (2011) provides additional information on ageing distribution across European countries (**www.futurage.group.shef.ac.uk**).

[ii] Persons aged 80 years or over (the "oldest-old") as a percentage of the population aged 60 years or over.

[iii] Persons in the category "currently married" include, where possible, also those in consensual unions.

[iv] Number of persons aged 15 to 64 years per person aged 65 or over.

[v] For a majority of countries, data for 2009 are taken from the Economically Active Population Estimates and Projections series (5th edition, revision 2009) of the International Labour Organization (ILO); for small countries, data are taken from the Main Statistics section of the ILO database on labour statistics (http://laboursta.ilo.org).

[vi] **http://esa.un.org/unpd/wpp/unpp/panel_population.htm**

[vii] There is a vast literature in gerontology that discusses issues associated with conceptualizing disability, functioning and health (e.g. see Freedman, 2011). In this non-technical document, we use them interchangeably. The terms are used broadly to include: reduction in person level physical, cognitive and sensory capacity, loss of ability to carry out tasks independently, and corresponding changes in how such tasks are performed; and limitations in the ability to participate in productive social and community life.

[viii] The expected number of healthy and functionally unrestricted years of life depicts the average length of healthy and unrestricted life a person of a certain age can expect to have

[ix] Several competing theories exist and the literature is still characterized by somehow mixed results. See. Freedman (2011) for a general overview.

[x] See Freeman (2011)

xi In order to capture disability, participants in the study were asked whether they experienced difficulties with one ore more activities of daily living (ADL) e.g., dressing, getting in and out of bed; instrumental activities of daily living (IADL) e.g., using a map, preparing a hot meal; and mobility and motor function, e.g., walking 100 meters, climbing stairs.

[xii] Education level was classified in SHARE into three categories according to the ISCED (international standard classification of education): levels 0-2 (pre-primary, primary and lower secondary education), 3 (upper secondary education) and 4-6 (post-secondary education).

xiii Wealth was defined as the sum of all financial and real assets. Wealth values were adjusted by purchasing power parity and subsequently reclassified into country-specific tertiles.

[xiv] OECD (2011) includes several issues related to pension incentives to retire – such as an analysis of the change in pension wealth from working longer as an measure of incentives to retire, and an analysis of how this vary with individual earnings), or the role of taxes and social security contributions - which are not summarized here. The interested reader is referred to OECD (2011) page 49-66

[xv] Interested readers are invited to consult the original documentation, available for download at **http://www.share-project.org** . The documentation provides more fine grained data and statistics concerning the status of employment of older workers.

[xvi] According to SHARE researchers, spending 3% of labour income on preventing poor health pays for itself by preserving employability.

[xvii] OECD, 2006. Live Longer, Work Longer

[xviii] Caution should be taken in deriving normative indications from these finding as studies differ on the way they conceptualize older workers

[xix] This may include are stressful features of job, such as stress related to frequent travelling etc.

[xx] This and following paragraphs are adapted from their work.