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TNO report

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Learning for life in older professionals

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Summary

In the western world a massive demographic landslide is going on towards an increasing proportion of middle-aged and older professionals and a diminishing number of younger ones to replace them. Some of the middle-aged and older people are able to cope graciously with changing circumstances, showing a proverbial kind of wisdom that is supposed to come with the years. Other older employees are thought to become less productive, inflexible and inadequate. This may lead to early retirement and demotion, i.e., a waste of human capital which cannot be compensated for by the young generations in the next decades.

In order to find solutions for middle-aged and older professionals to remain optimally fit and motivated to perform, the present report describes and analyzes the issue from several perspectives. This includes a literature review about the *societal*, *organizational* and *individual* factors that affect the employability, motivation and productivity of middle-aged and older workers. It is broadly documented that older subjects are hampered by a number of physical, perceptual-motor, and cognitive deteriorations that appear in later adult life. The major consequence of physical and perceptual-motor decay is that older people are less fit for heavy physical work or operating under extreme, enduring and aversive conditions. This counts for instance for 24/7 functions of military people and first responders and for other kinds of heavy jobs. In addition, the rise of our informational society has dramatically increased the cognitive demands and complexity of tasks. One conclusion in this respect is that previously acquired cognitive skills, e.g. learned at school or on the job, tend to remain effective in old age. However, when older people cannot rely on previously well-learned skills (e.g. low education), or when these skills have to be modified, negative effects of age are seen. This notion is supported by brain research. That is: relatively great neural losses in the prefrontal areas and in the hippocampus with increased age may degrade cognitive and learning skills required to keep up with the rapid technological changes. In addition, a number of relevant social and motivational factors hamper older workers to keep up with the rapid (technological) changes (although inter-individual variance is very high). Examples and relevant factors are related to: integrity and mistrust, self-efficacy, achievement motivation, emotional sensitivity, social network, time to go and return on investment, resilience to trouble and losses, and negative stereotyping. Under suboptimal circumstances at work (e.g. stereotyping, short-term management strategies) this may easily lead to under-achieving, over-specialized professionals with low (learning) motivation, and decreasing social (and formal) networks.

In order to obtain better employability of older workers the report concludes with the presentation of a long-term counter-policy, aiming at life-long development of capabilities. In order to support this, a framework for learning for life is presented. The framework is based on two dimensions: 1) *organizational-, technological-* and *didactical factors* and 2) *emotional-* vs. *cognitive factors*. Factors and notions under these dimensions include a.o.: self-control, social- and technological support, integration of learning and working, early diagnostics, collaboration, engagement, and control space. When this framework is further developed and integrally applied, it is supposed to produce enhanced employability, more commitment and increased motivation to learn and perform. This ultimately should turn out to more optimal use of human resource potential, increasing organisational flexibility, regressing turnover and sick leave and a decreasing risk of shortage of (key) employees.

Contents

1 Introduction

In the western world, the last few decades have been characterized by a rapid acceleration of societal, cultural, technological and economic change. In order to survive, many organizations and companies have to adapt to these changes in an ever increasing pace. This implies that this also counts for the employees who have to catch up with these developments

At the same time, demographic changes lead to a decreased influx of young people that is insufficient to substitute for the outflow of the middle-aged professionals.
This means that in the near future, organizations are dependent of an increasing proportion of middle-aged employees. In brief: societal and economical necessities will force older people to participate longer in the labor process. However, people differ in the way they grow older. Some of the middle-aged and older people are able to cope graciously with changing circumstances, showing a proverbial kind of wisdom that is supposed to come with the years. Other older employees feel that it becomes increasingly difficult to adapt to the changes to which they are exposed. Unfortunately, within organizations the second category of older people determines the overall picture. Personnel managers often consider their middle-aged staff as sources of problems, without much growth potential. Older workers are – often erroneously – thought to be less productive, inflexible and more liable to fatigue and illness. Consequently this may lead to a prematurely drop out leading to waste of knowledge, experience and wisdom and loss of (man) power that cannot be compensated for in the next decades.

The present report is concerned with the validity of this picture and with the underlying individual and environmental factors and the interaction between both. With regard to possible solutions, we will focus on the factors such as: cognition, learning and motivation. Political and physical/somatical issues and findings will be treated briefly, notwithstanding their evident importance. The reason for this is that we expect that, as an applied technology organization, TNO can have most impact on the psychological, educational and (psycho-) social variables.

In Chapter 2, we will start with a description and analysis of the phenomenon. Chapter 3 addresses the societal, organizational and individual determinants of aging-related problems of middle-aged and older professionals. Chapter 4 presents a global neuro-

physiological framework for the underlying causes of aging-related cognitive deteriorations.

Chapter 5 recollects the major findings, notions and conclusions and presents an integral framework enabling professionals to remain optimally fit and motivated to perform. The report ends with a number of open issues and research questions.

Since *aging* is a gradual process, progressing along many different dimensions in very variable ways (Salthouse, 1982, 1985a, Riemersma, 1999, ADHA, 2006), it is impossible to provide a consistent, universal, and valid definition of this concept ADHA, 2006). Therefore, in the present report, aging will be regarded as a compound statistical phenomenon related to chronological age in adulthood, becoming sufficiently powerful for working people and for behavioral applications by about 45 years of age or older.

2 Description of the phenomenon

The changed attitude to age is related to the speed of society's change. In a time when change was less prominent and less fast than it is today, old people were in a position to be wise and experienced. Nowadays, the world changes so fast that many older people loose their grip. Except for a few extraordinary individuals, they are at best seen as people trying their best to follow the developments. Following Boerlijst (1994), Panek (1997), Riemersma (1999), Schabracq (1994), and Thijssen (1987), this conception is only partly valid. Below, we present an overview of the supposed problems of middle-aged and older employees. This overview is structured as follows:

- decreased employability;
- decreasing motivation to achieve;
- decreasing (motivation for) extra schooling/training;
- isolation and decreased participation in networks;
- decreased multi-tasking capabilities;
- negative image and increasing individual variance.

These problems should not be considered and treated in isolation. Below, we will briefly describe and analyze the problems with older professionals.

2.1 Decreased employability

Professionals show a tendency to become specialists in their jobs (Thijssen, 1987). This is a highly conceivable and normal process: it is nice to be good at something. People become one with their jobs and their jobs become part of the integrity of their functioning. In the terms of Piaget (1950), learning becomes more and more a process of *assimilation* in which new experiences and information are incorporated in the existing cognitive schemata. At the same time, we see a decrease in *accommodation*, i.e., the process of adapting the existing cognitive framework itself to the new information.

However, as employees grow older, the process of specialization, i.e. becoming more and more proficient in a (limited) number specific area's, may lose its harmless nature. When knowledge and skills only develop within the narrow limits of their specific jobs, people may become overspecialized. This is termed: "*concentration of experience*" (Thijssen, 1987). Fears of possible loss of control may push older workers to stick to their domain and familiar competences. This may lead to deteriorated skills outside the specific job domain. This fits in with the relatively strong needs for conservation existent in middle-aged professionals. Whereas the younger are more inclined to change, progress and "advancement" (accommodation), middle-aged and older people are more directed to the maintenance of a *stable* environment (assimilation). According to Schabracq (1994) and Riemersma (1999) this symptom is aggravated by unfavorable *payment/productivity ratio*, which in turn, is caused by previous political measures (see Chapter 3). For instance, when opportunities arise for new tasks or jobs, project leaders will first search for the cheaper staff to participate in their projects. Hence, the number of opportunities that arise for new tasks or roles tend to shrink with increasing salary.

As a result careers show a definite ceiling effect: people cannot rise higher than their jobs or, in the best of cases, the top of their department. Employees become less mobile

and flexible when it comes to transferring them to other jobs or departments (Schabracq, 1994). As a consequence of these processes, middle-aged and older employees often end up being stuck in jobs that do not appeal to them (any longer).

2.2 Decreasing motivation to achieve

Because of concentration of experience, jobs do not longer appeal to capacities of the person, and thus become less challenging (Lang & Heckhausen, 2006; Schabracq, 1994; Thijssen, 1987). Professionals who operate many years within rather narrow boundaries become overspecialized, get bored and may feel somewhat alienated.
Meanings inherent in the job seem to dissolve, but the person still is supposed to pay attention to the task. This may lead to less focusing on work, concentration disturbances, lower performance and stress-related phenomena.

Also, when employees grow older, personal (work) objectives change, partly because major objectives to strive for have been obtained. This means that there can be a shift from advancement to consolidation (Lang & Heckhausen, 2006). From the point of view from the organization, many middle-aged people may show signs of demotivation (Schabracq, 1994). Middle-aged and older professionals also appear to focus less on objectives such as increasing wages and power and demand more from their jobs in terms of quality of their work life, freedom to arrange their work and usefulness. Ybema et al (2009) found that 16% of the older workers want to stop working before the legal age of retirement (65 in the Netherlands) because of undesired provokative behavior of colleagues. In contrast, a positive social climate, support and flexible work schedules makes them to stay. However, many jobs do have rather strict limitations with regard to the realization of all kinds of qualitative objectives that people may pursue. When older people realize that the actualization of these objectives is difficult, they usually turn more to leisure-time activities for their rewards, which may interfere with organizational interests (Schrabracq, 1994).

2.3 Decreasing (motivation for) extra schooling

The previous sections mentioned the high pace of technological, workplace and organizational change, concentration of experience and decreased motivation to perform. As a result the skills of middle-aged employees may become obsolete at a fast rate. The obvious thing to counteract these phenomena is to give these people additional training. This should keep them motivated and capable of keeping up with the numerous changes at work. However, nothing seems less true. Boerlijst (1994) showed that middle-aged professionals factually get little or no additional training.
Schabracq (1994) mentions several motives or causes of this phenomenon (see also Chapter 3):

- self-fulfilling prophecies (see Par. 3.1);
- (having to) change is perceived as a threat (to be resisted) (see Par. 3.2);
- popular but near-sighted management strategies (see Par. 3.2);
- “déjà vu” experiences of older professionals and suspicion of the real motives of managers behind change and reorganizations (see Par. 3.3.5);
- lack of formal schooling and low perceived self-efficacy (lagging too far behind (see Par. 3.3.5);
- slower learning with low perceived return on investment (see Par. 3.3.5);

– the inadequate nature of the training itself, that is for instance: insufficient practical application, not adapted to the older employee, conflict with their values (see Chapter 5).

In the next chapters, we will treat these motives more elaborately. Lack of additional schooling and training will reinforce concentration of experience and lack of mobility. According to Ybema et al (2009) this in turn may aggravate early retirement. This is extra detrimental in a time in which technology at the workplace and the ways in which work is organized is changing faster than ever. In cases where the professional is required to adapt to quick changes this may result in overload, stress and impoverished function. In the long run, the older employee may be left with some easy, but not so interesting, work. This results in a waste of potential labor resources. (Thijssen, 1987).

2.4 Isolation and decreased participation in networks

When working in an organization, people always develop a social network (Panek, 1997). This network is very useful for giving and receiving information, warnings, advice, emotional support, and factual help. A good network is crucial for the development and maintenance of a position in the organization, it helps to obtain a promotion and even may prevent dismissal. However, social networks appear to decay over years (Boerlijst, 1993, 1994, 1998; Schabracq, 1994). People leave, move elsewhere and middle-aged workers are confronted with a loss of support of persons who are important for their position. In addition, older people do not make new friends as easily as when they were younger (Schrabracq, 1994). Positions of older employees thus become more isolated and as a consequence they lose the yields of social networks. In our opinion, regressing networks may negatively affect all previously mentioned aspects of the problems with middle-aged staff, ranging from their motivation to learn and perform to negative conceptions that can interfere with their functioning within the organization.

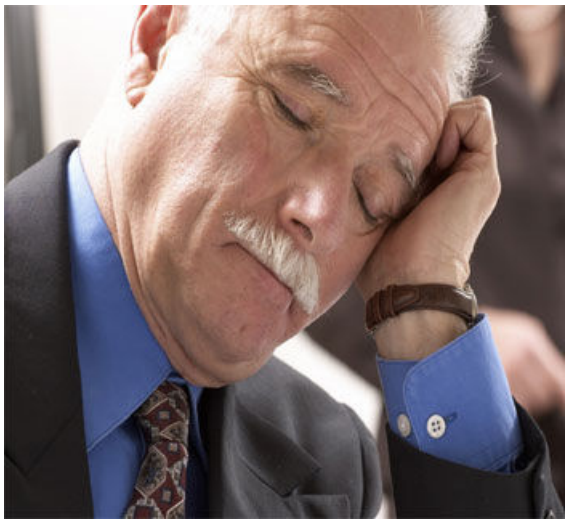
2.5 Decreased multi tasking capabilities

Recent technological innovations have altered the nature of jobs and tasks, that is, individuals are required to simultaneously monitor, control, manipulate and communicate information via complex technological systems. Such systems typically involve performance of several tasks in a limited period of time. A substantial body of literature shows that older subjects are more penalized than young subjects in such multiple-task situations (e.g., Kramer & Larish, 1996 for a comprehensive review). This may make middle-aged workers more susceptible to errors or accidents. In many laboratory studies, the decrement in multi-tasking performance, relative to single-task

performance, typically is found to be greater for older adults than for young adults (e.g., Broadbent & Gregory, 1965; Korteling, 1994, McDowd, 1986; Ponds, Brouwer & Van Wolffelaar, 1988; Talland 1962,). However, it should be noted that age effects found in laboratory task performance become smaller, or even disappear, when performance is measured in tasks that were well-trained before in daily life or at work(see Par. 3.3.4). It seems that the problems concern more those situations in which these skills or routines have to be modified or when new (multi-)task skills have to be learned (e.g., Cohn et al., 1984; Rogers & Fisk, 1991, Korteling, 1994; Kramer & Nunes, 2009). For instance, Korteling (1994) found that age-decrements in multi-tasking did not appear when well-learned skills (car driving) were previously acquired. Kramer & Nunes found similar results with regard to young and older aitraffic controllers. Besides, it should be noted that most multi-tasking situations at work often involve task switching, that is, serial alternation between different tasks, which cannot be regarded as real parallel task performance. On the basis of studies on cognitive control, sizeable increases in task switching costs in older individuals have also been reported (Kray & Lindenberger, 2000; Meiran, Gotler & Perlman, 2001). Older people may thus also have problems when their job requires quick alternation between different tasks (see also Chapter 4, see Sharp, et al. 2006 for a brief overview).

2.6 Negative image

It is almost inevitable that in thinking of middle-aged and older employees certain images come up that are rooted in our collective memory (Riemersma, 1999). The core of this image of the older may be characterized as a frailty person, physically weak, slow, forgetful and less motivated to perform. In other words: unproductive from an employer's point of view (Schabracq, 1994).



Although it is true that older people show more or less decay in several functions, as a generalization this conception is invalid and in certain aspects completely false. The generalization is false with respect to two major aspects: 1) the fact that it is possible to benefit from capabilities that remain stable or even grow with increasing age and experience and 2) the increasing inter-individual variance with age.

Ad 1) Functional deterioration with age varies substantially for different psychological functions (see Chapter 3, for an overview). For example, verbal functions and semantic long-term memory remain stable or even develop over a long time. Brouwer (1998) provides examples of post-formal thinking and practical wisdom. Wisdom is the

capability to see and integrate different perspectives, thus being able to reconcile apparent contradictions or conflicts. Post-formal thinking accepts contradictions and complex interactions as basic characteristics of (social) reality, thus relativizing knowledge and values.

Ad 2) Older people show loss of power caused by decay of physical and psychological resources (e.g., Panek, 1997). At the same time, a process of stereotyping confirms, reinforces, and even legitimizes this loss (ADHA, 2006). As a result older adults are, erroneously, seen as a more or less uniform group of people. Erroneously because, as middle-aged professionals, having lived longer and more diverging lives, they show more variance in performance than their younger counterparts (Salthouse, 1982, 1985a; Schabracq, 1994; Riemersma, 1999). This alone is a sufficient reason to abandon stereotypes and also develop a more positive image concerning the possibilities and value of older staff. At the same time older people with high levels of schooling usually can get more stimulating jobs, which offer plenty of opportunities for further development. As a result, the gap among the possibilities for high- and lower educated groups extends more and more (Kohn & Schooler 1983, Lee, 1991). This increases the individual differences among this group, such that, in practice, chronological age is a poor predictor of changes in performance (ADHA, 2006).

3 Underlying factors

The present chapter describes determinants that cause the presumed low employability, motivation, and productivity of middle-aged and older employees on three levels, i.e.: society, organization, and individual.

3.1 Society

3.1.1 Major societal factors

According to Riemersma (1999), who based this opinion on papers of the ministry of social affairs in the Netherlands, the major determiners of the low degree of labour participation of older workers are:

- High number of young people in the seventies and the political battle against unemployment among these young people entering the labour market.
- Rapid technological developments have resulted in rising qualification requirements. This was problematic for those (older people) with lower educational background. In addition, by the changing nature of tasks and required qualifications, many traditional jobs ceased to exist.
- Unfavorable payment/productivity ratio of middle-aged employees, especially for the lower-educated and technological specialists.
- The very attractive retirement regulations for middle-aged employees such as WAO, WW and VUT, that have remained, especially in the combat against unemployment among the young. According to (Ybema, Geuskens & Oude Hengel, 2009), the role of CAO needs further investigation, since favorable CAO appointments seem to promote early retirement.
- Pension: non-transferable pension rights are a very legitimate reason to stay, even with a better fitting job available elsewhere. Related to this are pension schemes in which the amount of the ultimate payment depends on the salary earned during the last working years. Schemes like this effectively block the acceptance of a less well paid, but less demanding job for the last working years (Schabracq, 1994).
- Young people having more negative and less positive biases about older people than the older themselves (ADHA, 2006). However, older people tend to take over negative stereotypes, which are partly erroneous. It is well-known that people use to adapt their behavior to norms and expectations of their societal environment.
  As long as generalizing negative conceptions about older people are omnipresent in society and in its constituting organizations, it is likely that also many middle-aged and older people will adopt this image and start to behave in accordance with it. According to Schabracq (1994). Taking over this stereotypical thinking degrades the older professional's motivation to perform, which makes the job less interesting and so on. They thus contribute to a self-fulfilling prophecy or so-called *NegativePygmalion effect*.

As a research organization, TNO cannot change the laws and we only have limited impact on public opinions and biases. However, we assume that the high societal needs for longer work participation will break the (existing) laws (and maybe negative image building around older workers). Nowadays we see already that the regressing offer of young people can not bear the burden of the high retirement and pension costs.
This means that society will be (economically) forced to enhance the participation of older people in the working population. Therefore the political and societal issues

concerning older workers will not be captured in the present report. Right at this very moment strong political measures are already taken or in preparation to let middle-aged workers participate longer in the labor process (e.g age 67 for retirement).
This, however, makes it the more crucial to deeply investigate the middle-aged workers' social, motivational and cognitive issues. In addition, the governments should fight against negative stereotyping and the resulting negative self-fulfilling prophecies. Only then society can benefit optimally from the long-term productivity potential entailed in the middle-aged and older professionals.

3.2 Organization

On the basis of the previous chapter we may conclude that there are many erroneous conceptions about older workers that interfere with an adequate aging policy of personnel managers (sometimes called "*agism*"). Thijssen (1997) has made an inventory of experiences of P&O advisors. On the basis of the results he postulated two dimensions of the policy, based on which four policies were defined. The most detrimental policy is a financial short-term policy aimed at reduced employability of middle-aged professionals (called the *Refreshment Strategy*). The policy to be advocated focuses on support and long-term objectives, flexibilization and development, e.g.: Groot et al. (1998), Smeulers (1998). According to this so-called *Development Strategy*, employability has to be fostered, but this can only be accomplished when it is learned by managers, by middle-aged staff themselves and by supporting professionals. At present, the development strategy is not yet dominant.
The main objective of the development strategy is to counteract phenomena described in the previous chapter, i.e. experience concentration, decreased motivation to learn and decreasing social networks. Ultimately this should lead to enhanced employability and increased motivation to perform and obtain new qualifications (von Berg, 1998).

Von Berg (1998) found that hardly any organization practiced a deliberate ageing policy of their personnel. However, whether or not the opportunities for ageing policy will be utilized depends also on image building among (lower) management in these enterprises. In this respect, Boerlijst (1998) investigated ten large-scale organizations in the Netherlands. One of the central findings was that most head managers cherished as highest goal an over representation of staff under 40. This ambition does not match with societal reality showing a rise of the proportion of 40+ professionals highly above 50%. This ambition also was in conflict with the overall opinion that 75% of 40+ staff had crucial utility for the enterprise and that 35% even was indispensable.

A second important finding in this study was the finding that 40+ employees were offered less opportunities for further development by extra training and schooling. Superiors consider 55% of the juniors and mediors at middle level and 40 % of those at the higher level to be at "the top of their ability". For seniors this percentage is around 90. Hence, transition to a higher function is deemed no longer feasible for these persons. It may be expected that employees will notice that they are seen as expensive and unproductive elements with minor prospects, to be handled instrumentally.
In that case, it is not very surprising that in the long run this employee thinks: "Whatever…… how long do I still have to go?"

A third result was the finding that according to the knowledge of managers about 60% of the 40+ staff did not participate anymore in formal networks such as committees, working groups, steering groups and project groups. This is rather painful since just when one is maximally capable to share (with younger people) knowledge and

experience, this is not accomplished. This lack in formal networks may lead to a diminished consultation or participation of older staff in determining company policy or changing work design. Introducing change without consulting the older and experienced worker may be conceived by them as a threat to their integrity of functioning and may invoke emotional resistance. As a consequence these people are hardly motivated to co-operate. This can easily become a group feeling in which old hands support each other in resisting the changes forced on them.

According to Riemersma (1999), an important underlying causal factor is the lack of incentives for managers to let well functioning 40+ staff develop themselves more broadly. Head managers are usually payed for quarterly figures. Since they usually stay only a few years in their function, they will not be able to harvest the fruits of better long-term policy. They are therefore more focused on short-term gain by pragmatic and instrumental utilization of older staff instead of cherishing their structural value in the last 20 years before pension.

As was mentioned in the previous chapter, middle-aged professionals factually get little or no additional training (Boerlijst, 1994). This is partly a matter near-sighted management. Personnel managers are still focused on the new influx of staff and especially the high potentials within. Middle-aged and older employees are seen as furniture with low expected return on investment. The idea that there is only limited time for an education to pay back is a serious myth among managers. Actually, middle-aged employees (45+) remain longer in their function than younger (25-40) ones: 10,4 *vs*. 4,2 years, respectively (Allen & Hart, 1998).

Finally, automatic promotion policies may form a source of trouble in the later stages of careers. In some organizations (such as the defence), employees are promoted time after time, eventually beyond their level of capability (*Peter's principle*). Elsewhere, incompetent employees are promoted to a formally higher, but in fact empty function (being "kicked upstairs"). In these cases horizontal mobility would be very refreshing and more cost-efficient.

In summary, on the level of organizations, some misconceptions about older workers (*Agism*) interfere with an adequate aging policy of (personnel) managers. These erroneous conceptions aggravate potential aging-related physical and psychological problems (see Par. 3.3) very seriously.

- Policy aiming at over-representation of 40- employees (not in-line with societal reality, absenteeism and indispensability scores).
- Low opportunities for further development by extra training and schooling.
- 90% of seniors is considered at the "top of their ability".
- Head managers stay only a few years in their function, are payed for "quarterly figures" and thus do not receive incentives for better long-term policy aiming at employability of older staff.
- Lack of involvement in (formal) networks (minimal sharing of knowledge with younger colleagues.
- Personnel managers are focused on the new influx of staff and especially the high potentials within.
- There should be only limited time for an education to pay itself back (actually, middle-aged employees (45+) remain over twice as long in their function than younger (25-40) ones).
- Automatic promotion principles in combination with *Peter's Principle* (employees being *kicked upstairs* beyond their level of capability, too little horizontal mobility).

3.3 Individual

Next to the lack of challenge and stimulation from the side of the organization, the older employee gradually notices some limitations. Some tasks still can be done, but require more effort and/or more time. Acquisition of new skills becomes more tiring and may slow a bit down. Older professionals may sometimes become more forgetful and they see that they are less excited than the younger generation with the modern technological opportunities and innovations. In contrast, they also become more experienced and efficient. Part of this is that they have been young too and thus by definition have a broader awareness about the pitfalls of being young, under-experienced and dynamic. In the present section we will provide an overview of changes with increasing age in the individual person. Since a huge amount of research has been done on this subject, we will briefly mention the functional changes. Detailed descriptions of the age-related changes mentioned below are available elsewhere (ADHA, 2006; Charness, 1985; Davison, 1978; Fozard, 1990; Kelly & Kroemer, 1990; Kline & Schieber, 1985; Koncelik, 1982; Panek et al. 1977; Salthouse, 1985a, 1985b; Stoudt, Damon, McFarland, & Roberts, 1965, 1973; Welford, 1977).

3.3.1 Physical and motor deterioration

Size changes
Height loss and weight gain, coupled with cohort differences that exaggerate these changes, i.e.: thanks to better nutritional, hygienic, and medical circumstances younger generations still become taller.

Aerobic capacity
Maximum metabolic capacity decreases (dynamic effort) from the twenties about 5-10% per decade. Though individual differences are huge depending on the amount of (heavy) physical activity of the person (at work and in sports) and on weight gain. Maximum metabolic capacity of women is on average 33% lower than that of men.

Physical Strength
Older people generally show declining muscle mass and muscle strength and increasing proportion of fat tissue. Individual differences are again massive and depend for example on kind of muscles, sex, hormones and on (training) activity. Problems due to lower muscle strength or lower endurance only may arise for heavy physical work. Speed of muscle contraction (response speed) and speed of recuperation after physical effort also decline with age.

Physical fatigue
Main factors causing fatigue in work situations are: heaviness, night-shifts, stress and sleeping disorders. Older workers are only more susceptible to fatigue when required physical effort approaches the maximum capacity. This maximum capacity decreases with increasing age.

Health
Middle-aged employees show less frequent absence caused by illness, but when they are suffering from a disease, they usually need more time to recover than their young colleagues. They show greater susceptibility to chronic conditions (e.g., arthritis, diabetes, osteoporosis, and hypertension). The presence of multiple chronic conditions is more likely. They are less accident-prone than their younger counterparts.

3.3.2 Perceptual deterioration

3.3.2.1 Vision

- Because of near focus declines severely, older people need reading glasses or bifocals. This is the most universal, and almost inevitable, vision problem with increasing age.
- Substantial decline in static and dynamic visual acuity (sharpness, discrimination of two points).
- Substantial decreased contrast sensitivity (luminance differences) for higher frequencies caused by transmission limitations of the eye media, pupil constriction, metabolic decay of the retina.
- Severely declined lens accommodation (speed and amplitude of getting a sharp image); at the age of 65+ there is hardly any accommodation at all.
- Increased susceptibility to glare (and slower recuperation from glare) and slower dark adaptation, make the older more vulnerable in nighttime driving or make older soldiers less fit for nighttime operations without visual aids.
- Loss in ability to discriminate colors (especially in the blue range); older people see more yellow.
- Less (1/3 compared with young adult) transmission of light through to the retina.
- Significant declines in useful visual field, and extent of the visual field.
- Less accurate eye motion (saccadic eye movements, stationary and pursuit fixation).
- Decreased motion sensitivity (central as well as peripheral).
- Older people suffer from a number of frequent age-related diseases resulting in visual dysfunction or direct affections of the visual system, such as diabetes, cataracts, glaucoma, and macular degeneration. According to Riemersma (1999), a substantial part of the problems in working situations are probably caused directly by insufficient perception of the relevant visual information.

3.3.2.2 Hearing

- Significant loss at high frequencies and some loss at middle frequencies. This can be partly helped by hearing aids.
- Greater susceptibility to masking by noise, especially at high and middle frequencies; also likely to be improved by a hearing aid.
- Many older people suffer from tinnitus, i.e. a continuous buzzing in one or both ears.
- Hearing losses are significantly greater for men than for women (mainly caused by noise exposure differences than physiological differences).

Exposure to noise (artillery for the military) is the most prominent factor in hearing loss. It has been shown that mean hearing loss increases quadratically with levels of exposure during the workers' career.

3.3.2.3 Tactile and equilibrium

- Decreasing sensitivity of skin and body receptors slightly affects the capability to discriminate tactile stimuli; differences among individuals and sensory modalities are huge and implications for performance under normal working conditions are minimal.
- Declining balance ability, which may make older people more susceptible to falling, which has more detrimental consequences for older people since bone density loss makes them more susceptible to fractures.

3.3.2.4 Taste, Smell

- Depending on the parameter measured, losses range from minimal to significant; possible implications for most normal working conditions are minimal.

3.3.3 Cognitive deterioration

3.3.3.1 Cognitive performance

- Declining spatial orientation and spatial comprehension.
- Decline in fluid intelligence (significant after age 65).
- Slowing in response time increasing with complexity of the task.
- Slowed problem solving, mainly due to working memory limitations.
- Decreased selective attention and divided attention (multi-tasking / task-switching), mainly in unfamiliar tasks.
- No decline in crystallized intelligence.
- No deterioration in familiar task performance.
- No decline in verbal functioning, is only limited by working memory decay and word-finding problems.
- Improving vocabulary and conceptual knowledge (some finding problems).

3.3.3.2 Memory Functions

- Strong decline in learning new skills and procedures (procedural memory).
- Strong decline in episodic memorization.
- Decline in uncued recall.
- Decline (primarily slowing) in learning ability; when given more time quality remains stable.
- Some decline in working memory (short-term), growing more severe in old age.
- Some decline in cued recall and recognition.
- Minimal decline in existing procedural memory.
- Minimal or no decline in existing long-term memory (i.e., professional knowledge and skills).
- No decline in semantic memory.

3.3.4 Job-related previous training and experience

In most jobs, people perform tasks in which they are specialized and skilled.
It is therefore an important question whether age-effects occur in skills, which were already well-learned before old age. It has been found that dual-tasks, consisting of well-trained (automatic) routines typically produce smaller interference effects, than dual tasks consisting of more controlled elements. Schneider and Fisk (1982), for instance, showed that dual tasks sometimes even can be performed without noticeable deficit when one of the tasks shows the characteristics of automatic processing. However, when these automatic routines have to be changed or adapted, this is more detrimental for the older than for young subjects (Korteling, 1993, 1994). Also, age-irrelevant tests generally involve familiar and over learned skills, such as verbal and lexical abilities that do not require active, self-initiated processes, whereas age-sensitive tests involve memory functions and the self-initiated cognitive control in new or unfamiliar tasks (e.g., Botwinick, 1977; Craik, 1986; Craik & Bosman, 1992; Deelman, 1993, Chasseigne et al. 1997) A few studies have evaluated the performances of older adults on previously acquired skills or over extended series of sessions.
The general picture, provided by these studies is that 1) initial performance differences between age-groups do not change with extended practice (e.g., Kausler, 1982; Salthouse, 1985b; McDowd 1986) and that 2) age-related performance differences are predominately found with respect to new or unfamiliar skills, i.e.: skills that were not acquired before old age (e.g., Fisk and Rogers, 1991, Kramer & Nunes, 2009).

Effects of age are usually smaller when knowledge or skills to be learned involve a familiar task domain. So, older people have no, or less, learning difficulty when new knowledge can be integrated in an existing knowledge framework, build on previous experience. These conclusions are consistent with the notions assimilation and accommodation that were invoked by Piaget in his book The Psychology of Intelligence (1950). These mechanisms were also reflected in the Concentration of Experience phenomenon, described in Par. 2.1.

Charness (1992) has reviewed field studies on car driving, driving accidents and correlational studies among laboratory and field measures on younger and older person's performance. Given the pervasiveness of age-related decay, he is intrigued by the lack of significant age effects in field experiments and the lack of correlation between laboratory and field performance data. He supposes that the perceptual, cognitive, and psychomotor changes that occur with increased age are outweighed by the experience that older people have accrued, enabling them to compensate for such changes. For instance, many experimental results suggest that expert problem solvers derive their skill by drawing on the extensive experience enabling them to quickly select and apply the best procedures for solving problems (Kirchner et al, 2006 for a brief overview). People are supposed to be skillful in an area because long-term memory contains huge amounts of relevant information, increasing with age. It permits subjects to quickly recognize the characteristics of a situation and indicates, often unconsciously, what to do and when to do it. Thus, our long-term memory incorporates a massive knowledge base that is central to all of our cognitive activities. It has also been shown that older people are able to compensate for functional decay by *strategic adaptations*. For example, Brouwer et al (1991, 1998) found that older drivers compensate strategically for difficulties in reaction speed, vision or vehicle control by for example, driving slower, and avoiding night-time- and rush our driving. The final explanation for the abundance of laboratory findings that do not match with field data (for example on productivity of middle-aged workers) is that, in contrast to most laboratory tasks, practical setting do not demand peak performances (Salthouse, 1984).

Because previously acquired skills tend to remain effective in old age (e.g., Fisk et al., 1988; Fisk & Rogers, 1991), we thus may expect age-independence or minor age-effects for professional tasks when these tasks were learned and trained before at school or on the job. When older people cannot rely on these well-learned skills, or when these skills have to be modified (which is usually the case in laboratory tasks) negative effects of age may show up in single-tasks or so-called multi-tasks (e.g., Cohn et al., 1984; Rogers & Fisk, 1991, Korteling, 1994).

3.3.5 Motivational factors

When people grow older, their outlook on life becomes different. Personal work objectives change and may interfere with organizational interests. Middle-aged professionals have learned that a further progression in their careers becomes more limited and realize that the time to go is finite. This makes them focus less on objectives such as increasing wages and power. For these reasons they demand more from their jobs in terms of quality of their work life, freedom to arrange their work and usefulness. Unfortunately, many jobs do not have to offer much when it comes to realization of such qualitative objectives. When older people realize that the actualization of these objectives is difficult, they may turn more to leisure-time activities for their rewards. From the point of view from the organization, these middle-aged employees show signs of demotivation (Schabracq, 1994). It has been noted before in this report that horizontal mobility would be very refreshing and more cost-efficient (than e.g. demotion, which is actually destruction of human capital). However, many older

employees are deemed no longer able or unwilling to work in different areas. Ybema et al. (2009) suppose that this may be caused, or aggravated, by remaining too long in the same position and lack of challenge. In line with this, Henkens, Dalen & Solinge (2009) found that early pension in older academic workers and managers was related to lack of challenge. On the basis of this, Ybema et al. (2009) predict that fostering mobility would prevent early retirement. Following Boerlijst (1994) and Ybema et al. (2009) it is therefore important to investigate why certain employees who are able to start elsewhere are not willing to do so. On the basis of the knowledge so far, we expect that much of the problem can be solved by an adequate and transparent company policy aimed at life-long development of capabilities and accompanied by a sufficient degree of (social-emotional-educational) support.

As was already briefly noted in Chapter 2, older professionals appear rather reluctant and less motivated with respect to *additional training and changes at work*. However, relatively little is known about overall age-related changes in emotion regulation, goal striving and work motivation (e.g., Kanfer & Ackerman, 2004). More insight in this process may be used to create more favorable conditions for effective self-regulation at work.

3.3.5.1 Dynamic stage model of learning motivation

In general, the training literature has acknowledged that learning motivation can be affected by individual and situational characteristics (e.g. Mathieu & Martineau, 1997) and that learning motivation exhibits a positive relationship with learning outcomes (e.g. Colquitt & Simmering, 1998). However, these positive relationships are often rather weak (e.g., Colquitt & Simmering, 1998). Cole et al. (2004) suppose that this may be explained by the fact that most researchers have adopted a static, rather than a dynamic view of motivation and that they consider motivation as largely uni-dimensional, not capturing motives and behaviors associated with qualitatively different motivational states. Therefore these authors adopt the *TransTheoretical Model* (TTM) of behavioral change, which was developed by Prochaska (1979) in the context of health and health behavior. This model has received an extensive amount of empirical evidence with regard to many kinds of behavioral change (Cole et al, 2004). According to this TTM model, learning motivation changes over time and individuals progress (or regress) through various motivational states. The principal construct of the TTM, stages of change, describes five stages in the change process, each characterized by different motivations (Levesque et al, 2001). Prochaska et al. (1992) describe five stages, from 1) the *Precontemplational* stage in which individuals are unaware or have no intention of changing at all, to 2) *Contemplation*, 3) *Preparation*, 4) *Action* and

5) *Maintenance* in which individuals focus on the prevention of relapsing to pre-change behaviors. Self-efficacy is an important component in the stage model. According to Prochaska et al (1992), a major benefit of the states-of-change approach to understanding motivation to learn is that it identifies processes that are used in each stage to facilitate stage advancement. Research has indicated that outside interventions that match to the stage of the person can more than double the likelihood that they will take action (Prochaska et al, 1993).

With regard to age we suppose that the basic underlying components and dynamics of motivational change do not substantially change in older adulthood. Hence the TTM framework may provide a useful approach to learning motivation in older employees. For instance, it may be very important to discern precontemplative older workers from contemplative ones since the former are unlikely to display own initiative, and therefore, it is doubtful that these persons will show learning initiatives when learning opportunities are available or offered by the organization.

3.3.5.2 Resilience and coping with stress

One important assumption on how people regulate their development troughout life builds on the idea that whenever people face challenges, losses or constraints (such as widowhood, an accident, or a severe disease) they activate motivational resources to enhance their adaptive capacities. This *resilience* is accompanied by emotional responses supporting the organism's mastery, reproduction, and survival when confronted with challenges and demands (e.g., Frijda, 1988).

Lang and Heckhausen (2006) discuss the ways in which people use motivational and regulatory strategies aiming at enhancing their potential to control the environment and to cope with (unexpected or uncontrollable) contextual change. According to their so-called *Life Span Theory of Control* there are two types of control striving across life course: primary and secundary control striving. Primary control relates to behaviors that aim at producing changes in the environment. Secondary control striving is directed at internal states of the self and serves to protect or enhance the motivational resources required to effectively control the environment (e.g., lowering one's expectations). Secondary control is expected to be functional when it contributes to enhanced primary control and to be dysfunctional when it obstructs the person's action potentials (Heckhausen & Schulz, 1995, Lang & Heckhausen, 2006). According to the theory, primary and secondary control strategies follow quite different trajectories across the life course. The adults' potential for primary control is reduced in later adulthood. Older adults are more likely to experience the challenges and constraints that cannot be mastered by actively altering environmental conditions. Therefore, mastery becomes more directed to the self and to the protection of one's motivational resources and action potentials (secondary control). This may explain the robust findings that older adults endorse quite negative stereotypes of aging as a negative reference frame against they fare well in comparisons to their own, more positive aging experience (Heckhausen & Krueger, 1993). As has been stated before (Par. 3.1.1) this may in some cases be a rather counterproductive adaptation strategy because it may lead to passivety and a low motivation to achieve, i.e., the *Negative Pygmalion Effec*t. Changes in the professional context (e.g., new procedures, new jobs, tasks or functions, new technologies or tools, new laws, decline of certain skills, new prospects) also require active efforts of the individual to adaptively mold this context in accordance with his or her capabilities and needs. Reduced primary control potential and negative stereotypes in older workers may lead to low resilience against professional changes and problems.

Following this line of reasoning, we noticed that there may be a relationship between the capability to cope with aging-related problems at work and traumatic experiences, such as the September 11 attacks. Both involve aspects of resilience, i.e. adapting in the face of adversity or trauma. Ai et al (2006) examined the impact of the September 11 terrorist attacks on graduate and undergraduate students and the role of optimism in posttraumatic distress. They showed that posttraumatic stress disorder symptom scores were positively related to personal loss and two types of previous trauma reactivated by the attacks, and levels of initial negative emotional response. Optimism was inversely associated with posttraumatic stress disorder symptom scores. Frederickson (2009) describes a study showing that people who were resilient after 9/11 showed more emotional complexity in coping with stress than less resilient people. They were better able to appeal to positive emotions and to switch between negative and positive feelings. They do not deny the negative aspects of reality, but they don't embrace it either.

According to Fredrickson (2009) this positivity, seen in resilient people, can be learned by non-resilient people. The crucial underlying variable here is supposed to be the interpretation of (life-) events that happen to the person, e.g. seeing a difficult stressfull job as a challenge to help you further. Closely related to resilience is the "hardiness" construct. This construct was first described by Suzanne Kobasa in 1979 and is often used for understanding resilient stress response patterns in individuals and groups (Bartone, Barry & Armstrong, 2009). Conceptually, hardiness was originally seen as a personality trait or style that distinguishes people who remain healthy under stress from those who develop symptoms and health problems (Kobasa, 1979; Kobasa & Maddi, 1984). Hardy persons have a high sense of life and work commitment and a greater expectation of control, and are more open to change and challenges in life. They tend to interpret stressful and painful experiences as a normal aspect of existence, a part of life that is overall interesting and worthwhile. While early tools for measuring hardiness had a number of problems (Funk & Kent Houston, 1987, Funk, 1992), these have been addressed, and there are now several reliable, and valid instruments for assessing the hardiness construct (e.g., Bartone, 2007).
Although resilience is relatively stable over time and across situations, there is good evidence that ie can be increased as a result of experiences and training (e.g., Zach, Shula & Inbar, 2007). This may also imply that employees may be trained to become more resilient, i.e., become more adaptive in the face of interpreted misery at work.

3.3.5.3 Summary of motivational factors and –effects

Taking the aforementioned together with the useful notions from the literature, motivational effects can be briefly described as follows:

1 From the point of view of older workers, the requirement to engage in additional training and to support all kinds of (organizational) changes at work may be experienced by them as a threat to their integrity of functioning (Schabracq, 1994).
2 It has also been mentioned that older workers have learned to mistrust the *real* motives for change of managers of the organization (Schabracq, 1994).
3 Current older generations show a relative lack of previous formal schooling which goes together with a low perceived self-efficacy in learning. This may even show as a perception of lagging so far behind that it will be impossible to catch up (Schabracq, 1994).
4 A higher degree of mobility during ones career may lead to delayed retirement. We conjecture that mobility and flexibility of employees can be promoted by an adequate and transparent company policy aimed at life-long development of capabilities and accompanied by a sufficient degree of (social-emotional-educational) support.
5 There is also robust evidence that the magnitude of emotional responses as indicated by physiological parameters, such as skin temperature or heart rate, are consistently lower among older adults as compared to young adults (Levenson et al, 1991, Levenson, 2000). This is especially true with regard to negative emotions. So, older subjects may be less sensitive than young workers to negative reinforcements at work and thus may be more inclined to act on positive reinforcements and/or follow their *own* rules.
6 Social interaction and collaborative learning is supposed to motivate older workers (Chi-hung Ng, 2008).
7 For older people, personal *return on investment* may be substantially lower than that of young people. Firstly, the efforts required to learn new skills (“costs”) are higher, whereas the number of years in which the subject can harvest the fruits of his training efforts is lower. Deciding for one goal, necessarily implies a decision against an alternative or action. Decisions to invest resources in learning activities for work mean that activities in other area’s (with maybe more immediate rewards) fall short.
8 With increasing age, primary control (active) is reduced, whereas secundary control (passive, saving resources) increases.
9 In the first half of adulthood gains typically prevail over losses, but from middle- to late adulthood many individuals experience a rather dramatic increase of losses (Heckhausen et al, 1989, Heckhausen, 1999). So resilience against trouble, problems, and discomfort becomes a more prominent personal factor in maintaining the quality of functioning when people grow older.
10 8 and 9 may reformulated in combination as the tendency with increasing age that people become more focused on *maintenance and prevention* of what they have acquired (low-risk, no-failure attitude) instead of focusing on *growth and promotion* (and accepting more risk and incidental failures).
11 Older adults endorse quite negative stereotypes of aging as a negative reference frame against they fare well in comparisons to their own, more positive aging experience, i.e., the *Negative Pygmalion effect*.
12 Older employees may be trained to become more resilient or hardy, i.e., adapt better and appeal to positive emotions in the face of interpreted misery at work.

4 Underlying mechanisms of age-related psychological decay

4.1 Slowing-complexity hypothesis

The underlying causes of cognitive deteriorations are much less well defined than for physical and perceptual decline. The experimental literature reports one major hypothesis explaining increasing age-effects in cognitive (complex) tasks: the slowing-complexity hypothesis. The slowing-complexity hypothesis is partly based on a large number of studies, documenting that older subjects are slower than their younger counterparts in almost all behavioral domains so far investigated (for reviews, see: Birren, Woods, and Williams, 1980; Korteling, 1988; Welford, 1977a; Salthouse, 1982, 1985a, 1985b). This generalized slowing (Birren, 1974) usually is regarded as a reflection of structural changes in the central nervous system, that is: cell death, metabolic changes and reduced blood supply. Peripheral processes seem less affected. Central degenerative processes may cause reductions in the strength of neuronal signals or the velocity of neuronal conduction, increases in random background activity, and persistence of earlier activations of neurons, thereby producing a lowered effective ratio of signal to noise (e.g., Welford, 1977a/b). This supposed lowered signal/noise ratio requires the system to integrate more information in order to reach the same degree of confidence (e.g., Crossman & Szafran, 1956; Gregory, 1957; Welford, 1958, 1981). Regardless of the factors determining decreased neuronal processing speed, Salthouse (1985a) has argued that this mechanism may explain a wide variety of phenomena, ranging from differences in elementary reaction time tasks to strategical differences in nonspeeded tasks, such as problem solving tasks. This position is supported by studies demonstrating that much of age-related differences disappear when differences in speed are statistically controlled (e.g., Hertzog, 1989; Schaie, 1989).

Many of the studies on age-related performance differences have demonstrated that age-effects increase with task complexity (e.g., Birren, 1965, 1974; Cohen, 1979; Gaylord & Marsh, 1975; Griew, 1964; for reviews, see Salthouse 1985a; Welford, 1977a). Complex tasks, involving elaborate 'central' processing of information (e.g., spatial transpositions or symbolic manipulations), typically show greater age effects than 'peripheral' tasks, which have a more simple and straightforward stimulus-response structure (e.g., Cerella, 1985; Cerella, Poon, & Williams, 1980. These findings have been elaborated with the notion that cumulative slowing in successive processing steps causes performance differences between age groups to increase with the number of required processing operations (Cerella et al., 1980; Hale, Myerson, & Wagstaff, 1987; Myerson, Hale, Wagstaff, Poon, & Smith, 1990). Based on meta-analyses of data collapsed across studies in which reaction time (RT) performance of young adults was plotted against that of older adults for different speeded tasks, Cerella (1985) and Cerella et al. (1980) found a linear relationship. Hale et al. (1986) and Myerson et al. (1990) even found an exponential relationship. Slopes typically range between about 1.2 and 2.0. These studies indicated that speeded performance of the old subjects can be predicted on the basis of younger subjects' performance, without regard to the kind of task used. Therefore, task complexity, as indicated by the young subjects' performance, may be conceived as a parsimonious and overall predictor of aging-related performance differences.

4.2 An explanatory framework

Since everyday life provides us with many examples in which the older are slower than the younger, the use of generalized slowing for explaining age-effects in (complex) dual tasks seems to be intuitively appealing. In addition, processing speed conceptions are compatible with the occurrence of degenerative processes in the nervous system in old age.

However, theorists have not provided a generally accepted underlying mechanism that can explain precisely how neuronal degeneration causes generalized slowing and other phenomena related to cognition, attention, motivation, learning and memory.
Actually the framework tends to neglect immediate consequences of one of the most pronounced basic facts of aging: a location-specific decrease of neuronal connections accompanied with hypertrophic changes in neuroglia and decreasing plasticity.
With increasing age, the number of cortical axon and denditric terminals decreases ultimately leading to the loss of entire neurons (e.g., for reviews see Bondareff, 1975; Brody and Vijayashankar, 1977; but see Cragg, 1975). According to Bondareff (1979), the loss of synapses is not a secondary consequence of loss of entire neurons.
This means that the loss of neuronal connectivity can be regarded a major candidate for aging-related behavioral phenomena.
Furthermore, it is obvious that the brain cannot be dealt with as a uniform, unstructured organ. Neuronal decline does not occur in a homogeneous way, but concerns only selective parts of the brain. These differences must be taken into account in explaining variations in structure and function with increasing age in adulthood.
With age, total brain mass shrinks 10-15% in the normal aged (Wisniewski and Terry, 1976). Of the structures studied, the prefrontal and superior temporal areas of the neocortex and the hippocampus appear the most affected (Brody, 1973; Brody & Vijayashankar, 1977; Critchley, 1942; Haugh, 1985; Scheibel & Scheibel, 1975; Tomlinson & Henderson, 1976). Other brain areas, associated with other functions, (e.g., inferior temporal gyrus and inferior olivary nucleus) show little or no degeneration with increasing age (Brody, 1973; Brody & Vijayashankar, 1977).
The Generalized-slowing conception does not take in account the specificity of these neural changes with aging.

In addition, many functional effects of age are compatible with neuropsychological (Albert & Kaplan, 1980; Fuster, 1980) and neuropathological (e.g., Scheibel & Scheibel, 1975) evidence for a disproportional decline of the prefrontal system and hippocampus with increasing age. Of the most affected areas, the prefrontal areas are associated with behavior(or cognitive) control, adaptation, motivation and flexibility, that is self-initiated programming, monitoring, and modification of behavior such that it becomes appropriate to the peculiarities of various (new) situations (see Sharp et al, 2006 for an overview). The aforementioned problems with the modification of existing skills requires inhibition of automatic psychomotor routines. This is one of the most important aspects of behavior control, which is a main function associated with the prefrontal areas (e.g., Luria, 1973). Prefrontal damage, for example, is the most prominent cause of perseveration of automatisms and routine actions (e.g., Fuster, 1980). Frontal lobe dysfunction also leads to difficulty in coping with new situations, a change that is expressed clinically in perseverative and stereotyped responses (Shallice 1988). Functional imaging studies show that the amount of frontal lobe activity is related to the novelty of a task. Activity within the frontal lobe has also been shown to decline with practice (Raichle et al., 1994; Jansma et al., 2001); a pattern

that has been interpreted as resulting from a reduction in the requirement for cognitive control, i.e., shifting from controlled to more automatic information processing (Jansma et al. 2001). These findings are in accordance with the notion that older individuals show less cognitive flexibility (e.g., Chasseigne et al. 1997) and have difficulty with novel situations (laboratory tasks). The neural system involved in cognitive control clearly reflects this change. Next to this, the hippocampus also shows neuronal decay with increasing age. This region is particularly associated with memory functions. As was mentioned in the previous chapter, these functions also show relatively strong defecits in older people.

The relatively great neural losses in the prefrontal areas and in the hippocampus thus reflect a global distinction that can be made between abilities that are relatively sensitive to the effects of aging and abilities that are less sensitive. Age-irrelevant tasks generally involve familiar and overlearned skills, such as verbal and lexical abilities ("crystallized") that do not require active, internally generated processes ("fluid"). In contrast, age-sensitive tasks involve short-term memory load, learning and the "self-initiated manipulation of unfamiliar materials" (e.g., Botwinick, 1977; Clark & Knowles, 1973; Cornelius, 1984; Craik, 1986; Craik & Bosman, 1992; Deelman, 1993; Denney, 1982). Provided the aforementioned high inter-individual variances among older people, this means that affected areas are related to behavioral control, motivation, and adaptation (flexibility).

5 Conclusions and possible solutions

5.1 Inroduction

In the present decades a massive demographic landslide is going on towards an increasing proportion of middle-aged and older professionals and a diminishing number of younger ones to replace them. This revolution may lead to a severe waste of human capital, which will have dramatic consequences for each organization that has to struggle for sufficient and proficient personnel. Understaffed organizations, like the defense, are extra vulnerable to these problems. Therefore, innovative counteraction is required.

5.2 Overall picture

5.2.1 The phenomena.

On the basis of the information contained in the previous chapters we can construct an overall picture of the problems encountered in middle-aged and older workers.
This picture can be summarized as:

- Decreased employability (over-specialization, concentration of functioning).
- Decreasing motivation to achieve (boredom, consolidation).
- Decreasing (motivation for) extra schooling.
- Isolation and decreased participation in (in)formal networks.
- Decreased multi tasking capabilities (especially switching in unfamiliar tasks).
- Negative image and increasing individual variance.

These problems should not be considered and treated in isolation.

5.2.2 Causes and consequences

Most of these problems are basically caused by political choices, misconceptions of organizational and personnel managers and a number of physical, perceptual-motor, and psychological deteriorations that appear in later adult life. The societal and physical/somatical issues were treated more briefly than the psychological and organizational ones, notwithstanding their evident importance. One of the major conclusions concerning cognitive task performance is that previously acquired cognitive skills tend to remain effective in old age. When cognitive skills were learned and trained before at school (writing, calculating) or on the job age-effects for professional tasks use to be minimal or absent. In contrast, when older people cannot rely on previously well-learned skills, or when these skills have to be modified, negative effects of age may show up. A major consequence of *physical and perceptual-motor* decay is that older people are less fit for heavy physical work or operating (or learning) under extreme and aversive conditions, i.e., in operations characterized by combinations of nighttime, outside with poor weather conditions and with heavy and enduring workload. This should be taken into account when continuing operations require heavy physical effort, e.g., in military operations or the work of first responders. When working in a hostile or unpredictable environment (stress), at night, with extreme low or high temperatures or at high altitudes, performance of older people will become disproportionally poor. More research could be done focusing on the factors affecting the older subjects' performance most.

Fortunately, many operations and many professions in our modern society are not performed in aversive environments. In the last decades our society has rapidly changed from an industrial society to an informational society. Examples are associated with ICT- and internet-related facilities, industrial robotics, flexible manufacturing systems, advanced communication systems, and office automation. These kinds of technological developments have made individuals to become controllers of energy and information, instead of sources of energy. Consequently, many of the ageing-related physical and perceptual-motor problems can be (and have been) solved by introduction of proper ergonomic and environmental adaptations and/or by the large-scale automation that has characterized industrial processes during the last decades. This has contributed to the beneficial fact that middle-aged and older workers show nowadays for example less absenteeism caused by illness. In conclusion: in many normal work conditions, problems resulting from physical and perceptual-motor decay in older adults can often be compensated for by behavioral adaptations and ergonomic adaptation of the working place.

However, there is also a negative side related to the upcoming of informational society and the speed of technological change. Whereas this has lowered the physical and perceptual-motor demands of tasks, the cognitive demands and complexity tasks have increased dramatically in the last decades, with an ever increasing pace. In this regard, brain research and neuropsychological studies have shown a broad trend from neuronal plasticity and adaptation, in young people, to neuronal inertness and stabilization when people grow older. The relatively great neural losses in the prefrontal areas and in the hippocampus are consistent with many experimental findings concerning age-effects on task performance. That is: tasks that are insensitive to the effects of aging generally involve familiar and over-learned skills, such as verbal and lexical abilities ("crystallized"), that do not require active, internally generated processes ("fluid"). In contrast, age-sensitive tasks are usually complex and involve short-term memory load, quick learning, adaptation and the self-initiated manipulation of unfamiliar materials. This means that a number of relevant cognitive skills and the acquisition of new skills required to keep up with the rapid changes may be hampered with increasing age. Under suboptimal circumstances at work (stereotyping, short-term management strategies) this may easily lead to over-specialized professionals with low learning motivation, low resilience, low self-efficacy, concentration of functioning and decreasing social networks.

Therefore, the upcoming of the ever-changing information society may pose serious problems for older workers and thereby a waste of human capital (i.e., ultimately leading to early retirement or demotion). In order to survive, organizations will have to create the right opportunities, support and incentives to keep the middle-aged and older worker up-to-date and capable of keeping up with the changes and innovations at work. Therefore, in the next paragraph we will present a framework of psychological, motivational and didactical (not physical) measures that seizes on those aspects of the problem.

5.3 Framework for a solution

5.3.1 Requirements for learning for life

The main objective of the approach must be counteracting the social, motivational , and cognitive phenomena described in the previous chapters. We conjecture that this can be

obtained by an adequate and transparent policy aimed at life-long development of capabilities and accompanied by a sufficient degree of (social-emotional-educational) support. In this connection, we advocate here an approach aimed at *learning for life*. Learners for life can be described as (mostly) adults who have a flexible and pro-active attitude towards learning and developing themselves. On the basis of the information on older learners described in this report, we suppose that effective learning for life is very well possible provided that a number of preconditions is fulfilled.

Below, we present here some major preconditions and notions, with regard to successful implementation of learning for life with regard to older workers:

1) In order to ensure that middle-aged and older employees keep grip on the rapid developments in modern work environments, they should be stimulated and supported to adopt a learning-for-life attitude. This means that the thresholds to learn should be low and learning should be integrated and implemented into the real working environment. This enhances the older workers' motivation to learn, because they will recognize the problems they are asked to solve and the solutions that come out will be relevant for practical applications. As was noted before, low tresholds and direct practical relevance (authentic learning context) is especially valued by middle-aged and older workers.

2) At the organizational level, job policy must be aimed at stimulation and activation and not at regulation and repression. Therefore, the misconceptions of (personnel) managers affecting organizational personnel policy (mentioned in par 3.2) should be challenged. For example, sufficient control space must be provided, firstly in order to adapt to contextual changes in accordance with one's own capabilities and needs, secondly to ensure that older workers can (strategically) compensate for possible functional decline on the basis of their experience and expertise and by performing their work differently. Other major aspects of organizational support are a suporting emotional atmosphere, involvation in (formal) networks, provision of information and serious rewards (e.g. for a positive and engaged attitude).

3) Provided that interpersonal variation among older people is huge, they show reduced primary control potential and negative stereotypes about themselves. They are also less adaptive and tend to passive and dysfunctional secondary control. At the same time, trouble, problems, and discomfort become more prominent personal factors in maintaining the quality of functioning when people grow older. This may lead to low resilience against professional changes misery and (emotionally) threatening events. Therefore, non-resilient workers should be identified as soon as possible and counter measures (e.g. life coaching) should be taken.

4) The learning for life approach should be adapted to the preferences and needs of middle-aged and older learners. For example, according to Piaget (1950), in older people learning becomes more and more a process of *assimilation* in which new experiences and information are incorporated in the existing cognitive schemata. At the same time, we see a decrease in *accommodation*, i.e., the process of adapting the existing cognitive schemata themselves to sudden and large innovations. Older people thus have to *continuously and gradually* assimilate changes and new information, instead of *discontinuously and occasionally* having to accommodate to large and profound changes.

5) In connection with the concept of learning for life, the concept of *self-directed learning* should be mentioned, i.e., the learner is in control of his/her own development

and education (Collins, 2004). Collins states that the optimal adult learner is a self-directed, self-motivated manager of personal learning who collaborates actively in the learning process and who takes responsibility for learning. In interaction with the environment the learner decides what he needs to learn and how he can achieve this. According to Stubbé and Theunissen (2008) there was no real classification of elements supporting self-directed learning available yet. They have identified the essential elements of self-directed learning that should be integrated into a ubiquitous learning environment for adult learners in their workplace. These elements are: *learner control*, *self-regulating learning strategies*, *reflection*, *interaction with the social environment* and *interaction with the physical working environment*. In combination, these elements stimulate self-directed learning. Self-directed learning makes also concessions to adaptive learning, since choices for learning content and form are actively made by the learner himself, instead of by the learning system. In addition, taking responsibility for self-directed learning should be learned and supported. According to Stubbé & Theunissen (2008), this is possible. We suppose that this also counts for middle-aged and older professionals, provided that the aforementioned social, emotional and cognitive factors are embedded into an integral approach.

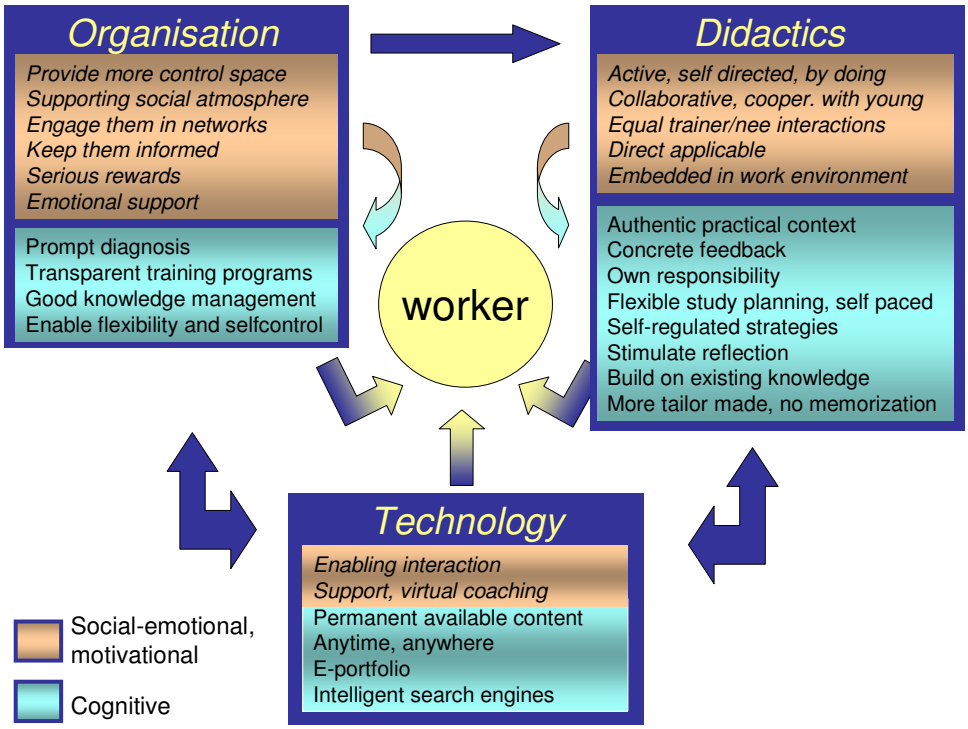
6) Self-directed learning with adults should be supported or facilitated by a *ubiquitous learning envi*ronment. Following Stubbé and Theunissen (2008) who studied the relevant articles, a ubiquitous learning environment is defined here as: *a permanent learning environment providing right and adequate information that is immediately accessible anytime anywhere, that enables interaction with experts, teachers or peers and is embedded in real life situations*. The advantage of a ubiquitous learning environment is that learning can take place anywhere and anytime, independent of the interface (PDA, laptop, cell-phone) and thus also (or especially) during work.
The learner is always in control and thus free to make his/her own educational decisions. A ubiquitous learning environment allows and supports this freedom to choose if explicit information on learning strategies and their use are available in the learning environment (Azevedo, 2007; Schraw, 2007). That is: the learning environment should support the learner to choose a learning goal, and stimulate the learner to reflect on his/her development regarding the chosen learning goal.
Both support and freedom to choose should be especially advantageous for older people because older people are more heterogeneous and need more (emotional and tailor-made) support.

7) The use of learning strategies, reflection (contemplation) and (social-emotional) support will be stimulated by collaboration and cooperation with peers. A learning environment can be characterized as being collaborative if the learners are actively communicating and interacting with each other with the intention to establish a common focus and achieve a common goal. This social interaction and collaborative learning is supposed to motivate older workers (Chi-hung Ng, 2008).

5.3.2 Framework

In the previous chapters, many if these kinds of age-specific phenomena have been described and elaborated on (e.g.: Cremer, 1994; Holm, 1994; Schrabracq, 1994; Riemersma, 1999; Chi-hung Ng, 2008; Delahaye and Ehrich, 2008;). On the basis of the age-specific phenomena of the previous chapters and on the main notions and precondition described above we have constructed a framework for learning for life in older workers. Figure 1 shows this framework, which is built on two dimensions. First the distinction between *organisation, technology and didactics* and second between *social-emotional and motivational* factors at one hand (red) and *cognitive* factors at the

other (blue). From the arrows it can be seen that the process starts with the emotional and motivational factors under organisation and didactics. These factors form the bottom line. Without proper emotional and motivational support most learning innovations are doomed to failure. The double arrows between Organsation and Didactics at one hand and Technology at the other show that the technological factors can substantially support the adoptation and implementation of organisational and didactical improvements (provided that Technology is sufficiently adapted to Organisation and Didactics). The arrow above from Organisation to Didactics show that the organisation has to provide some necessary conditions (such as control space) that enable e.g. self directed learning in an authentic working context.



As can be seen, the issue of employability and motivation to learn in older professionals is highly complex, multi-factorial, and can be approached from various perspectives. Both dimensions contain a number of factors and these factors affect each other over dimensions. For example: lack of support in adopting new ways of working with new technologies (e.g., intranet) may aggravate a lack of affinity with the latest technological innovations in older people, for example using social networking facilities. This may have consequences for involving older subjects in new initiatives or innovations by their managers, which, in turn, affects social contacts with young fellows in (formal) teams. This may lead to a decreasing social network of peers, such that older workers may not ask for help from colleagues when confronted with problems (collaborative learning). This may lead to overload, less rewards, lack of information, a passive attitude, and eventually a lower feeling of well-being and so on…. This makes the issues concerning motivated learning for life highly complicated and requires an integral approach, taking into account the multiple aspects as presented in the framework. This framework can be used as a starting point for the implementation of learning for life in organizations.

The approach advocated here requires a fundamental change in attitude and orientation from many individual (older) workers *and* from the organization. The individuals have to accept more responsibility for their own job or career. This however should be stimulated by the organization by offering (technological) support, opportunities with low thresholds, and rewards. Of course, the resulting gain of control of employees results for the managers in charge of organisations in a certain loss of control power. This loss, however, is compensated by enhanced employability and increased motivation to perform and obtain new qualifications, which ultimately should lead to more employee trust and commitment, more optimal use of human resource potential, increasing organisational flexibility, regressing turnover and sick leave and a decreasing risk of shortage of key employees.

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7 Signature

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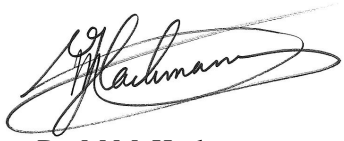

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1 ex.	TNO Industrie en Techniek, Eindhoven, drs. W.J.C.P. Jansen
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8 ex.	TNO Defensie en Veiligheid, vestiging Soesterberg, Business Unit Human Factors, dr. A. Bronkhorst dr. N. Theunissen dr. M.L. van Emmerik dr. ir. M.M. Hackmann dr. J.E. Korteling (4 ex.)