Chapter 8

General discussion
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The overall aim of the ‘Shift Your Work’ study was to contribute to a better understanding of sustainable employability of older shift workers by implementing new shift systems. This aim was derived from two initial premises: 1) shift work becomes more burdening with older age, and 2) sustainable employability can be enhanced by implementing new shift systems. These premises were examined in two parts, in which no convincing evidence was found either supporting or opposing the two premises. In Part I, hardly any age-related effects were found. In comparison with age, chronotype seemed to better explain individual differences in sleep and need for recovery. Even though in Part II a few positive associations for the design of a shift system with health, work functioning and social life were found, the evidence was weak and new shift systems deemed hard to be implemented.

In this chapter, the findings of the ‘Shift Your Work’ study will be discussed in view of the scientific literature and environmental and societal trends. Methodological considerations will be addressed and the chapter will be concluded with implications and challenges for research and practice.

Part I: The ageing shift worker
In Part I three studies were conducted to examine the effects of shift work on outcomes related to sustainable employability within different shift systems, with a special focus on age.

Main findings
In Chapter 2 individual and work-related predictors of shift work exit were examined among older and younger male shift and day workers. Shift work exit was operationalized as temporarily being placed in less strenuous work, long-term sickness absence and leaving the organization. Earlier studies already showed that adverse health effects of shift works did not lead to more sickness absence or higher risk of leaving the organization for shift workers compared to day workers (1, 2). Our study adds that also the predictors of shift work exit do not seem to differ in direction and magnitude, neither between shift and day workers, nor between older and younger shift workers.

In Chapter 3 we examined associations of chronotype and age with shift-specific assessments of sleep duration, sleep quality and need for recovery. There are indications that sleep problems and need for recovery increase with increasing age (3-5). Yet, in line with previous research (6), we only found associations for chronotype and not for age. Compared to early chronotypes, late chronotypes reported shorter sleep duration and more awakening complaints during morning shifts. No associations were found for evening and night shifts.

In Chapter 4 we investigated need for recovery among male technical distal on-call workers. Distal on-call work refers to a working time arrangement in which workers during on-call periods may stay at home and can be called back to the workplace in case of an emergency. According to Dutch working time legislation, distal on-call work is considered resting time (7). Levels of need for recovery when on-call were similar compared to morning shift peri-
ods and 1.5-2 times higher compared to regular working periods, even when workers were not called during an on-call period. Furthermore, we found associations for higher need for recovery with lower scores of sleep quality and mental health symptoms and higher scores of fatigue, work demands and work-family interference. In this chapter too, we found no differences for older compared to younger workers.

Reflections on findings Part I
The main results of the three studies in Part I showing no age-related effects are in line with the inconclusive evidence summarized by two earlier reviews (8, 9), questioning whether policies and interventions should be specifically aimed at older shift workers. Yet, research findings in the general (working) population and observations during the ‘Shift Your Work’ study (e.g. conversations with shift workers and their supervisors and occupational physicians) do suggest that shift work becomes more burdening with increasing age.

The premise that shift work becomes more burdening with older age builds upon the adverse health-effects of shift work in combination with health deterioration and increasing vulnerability when physiologically ageing (10-12). A meta-analysis in the general population of healthy participants aged 5 to 102 years old showed decreasing sleep length and efficiency with increasing age (3). In combination with earlier phasing of the circadian clock (13), this may provide an explanation why in particular older shift workers seem to have more difficulties with night shifts (8). Research in the general working population has shown that with increasing age need for recovery increases (4, 5), chronic diseases are more prevalent (14, 15) and sickness absent spells last longer, although older workers are less frequently absent from work (16). Shift work in turn is associated with an increased risk of developing sleep problems and chronic diseases (17-19). Yet, at the intersection of shift work and age evidence is lacking and we did not find age-related differences in sleep, need for recovery and predictors of sickness absence either. Several possible explanation for the null-findings of age-related effects may apply.

It may be that other characteristics than age better explain individual differences in outcomes related to sustainable employability. We did not find associations for age with shift-specific assessments of sleep duration and quality and need for recovery, but in congruence with other studies (6, 20) we did find decreased sleep duration and sleep quality for late compared to early chronotypes during morning shifts. Chronotype is age dependent, showing a later orientation in adolescents shifting towards an earlier orientation with increasing age (21, 22). However, a very late chronotype will never become a very early chronotype. Chronotype might therefore be an important concept to explain age-related differences in immediate outcomes, like sleep and need for recovery. Yet, associations of chronotype and general outcomes measures (i.e. non shift-specific measures like general health, performance and work-family conflict) are less well established, showing positive associations for both early and late chronotypes or no associations at all (9). Perhaps, differences in sleep duration and
sleep quality between early and late chronotypes for morning and night shifts might counterbalance each other, resulting in inconclusive results for these general outcome measures. Another reason for only few to no age-related effects might be the healthy worker effect. The healthy worker effect refers to that those workers best fit for and able to adapt to work will be selected for and stay at work (23). There are two indications of a healthy worker effect in our study; 1) similar scores of our study sample on health, work functioning and work-family balance compared to other healthy work populations (5, 24-26) and 2) the relatively few older shift workers. The healthy worker effect is difficult to assess due to logistical and time-based constraints. There is some evidence of selection into shift work (27). In concurrence with other studies, we did not find evidence for selection out of shift work (1, 28). The Dutch tendency to favor regulations to “spare” older workers (29, 30) might have veiled selection out of shift work. Amongst traditional age-based human relation policies (e.g. training, demotion, accommodation and early retirement), early retirement was most common in the Netherlands. Return on investment of training older workers is considered limited (31), demotion might have an adverse impact on employee satisfaction and productivity (32), and in the industrial sector examples of accommodation in terms of part-time employment or individualized schedules are scarce.

Next to selection effects, the healthy worker effect also includes adaptation strategies. The industrial shift workers included in Part I have been working in shifts for the vast majority of their working life. Over time, initial effects might have played themselves out. Adaptation strategies can be developed to minimize the adverse effects of shift work and may become more effective with increasing age. A well-known adaptation strategy is taking a nap to minimize accumulation of sleep loss, e.g. early chronotypes take naps of up to three hours before night shifts to compensate for anticipated sleep loss (33). In Chapter 3, about one third of the shift workers reports to nap after morning shifts or before night shifts. Another example of an adaptation strategy is to use the advantages of shift work to reorganize family life, e.g. tag-team parenting to avoid childcare (34). In the Netherlands, parent child interaction is at least equal, if not more, for shift workers compared to day workers, in particular for male shift workers (35). These mechanisms might especially play a role in the, male dominated, industrial sector.

Part II: Enhancing sustainable shift work employability by implementing new shift systems?

The three studies of Part II investigated the design of a shift system, in particular the process towards implementing new shift systems, and its effects on health, work functioning and social life.

Main findings
The focus in Chapter 5 was on the design of the shift system. We examined among a large
number of shift schedules associations between eight on ergonomic criteria based shift schedule characteristics (36) and sleep, need for recovery, fatigue, health and work functioning. These eight criteria comprised the 1) number of consecutive shifts, 2) start time of the morning shift, 3) number of consecutive working days, 4) direction of rotation, 5) number of annual weekends off, 6) number of recovery days, 7) number of rest days before a night shift and 8) average weekly working hours. We only found a few significant associations, of which the majority was in support of ergonomic shift scheduling recommendations.

In Chapter 6, we examined facilitators and barriers for the implementation of a new shift system. Interviews were conducted among production managers, trade unions and workers of six companies, of which three companies successfully implemented a new shift system and three companies cancelled the implementation. We identified framing the intervention in terms of production benefits, or at least no losses, as a facilitating factor. Barriers were alterations of current employment terms and involvement of headquarters and trade unions.

In Chapter 7 we examined the influence of workers’ attitude towards a shift system change and changes in health, work ability, work functioning and work-family interference after implementation of a new shift system. The study was conducted among five different organizations, which implemented a new shift system due to various reasons (e.g. to enhance sustainable employability). We found that a positive attitude of workers towards a new shift system before implementation was prospectively associated with a decrease in mental health symptoms and an increase in work ability and work-family balance after implementation.

Reflections on findings Part II

The implementation of new shift systems to enhance sustainable employability deemed to be challenging. New shift systems have a large impact on workers and organizations. For shift workers a new shift system may affect the distribution of free days and the financial compensation for working in shifts. Organizations need to arrange a transition period and possibly reconfigure the skillset of their workforce. In our study the sense of urgency to change might have been low due to a relatively healthy population, ergonomically already sound shift schedules and the economic crisis. When implementing a new shift system, the process towards implementations seemed to be as important as the design of the shift system.

A key concept in change management is creating a sense of urgency (37). A relatively healthy study population, shift schedules adhering to the ergonomic recommendations of a fast forward rotating shift schedule (36, 38-41) and the absence of extreme shift schedules (e.g. > 5 consecutive night shifts) might have led to a low sense of urgency to implement new shift systems in in the organizations in our study. The small variety in shift schedules in combination with a relatively healthy population might explain why we only found a few associations with small effect sizes for shift schedule characteristics with the outcomes health and work functioning. In addition, the “Shift Your Work” study was conducted during the
worldwide economic crisis lasting from roughly 2008 to 2012. During times of economic recession, interventions aiming to enhance sustainable employability might be hard to implement. Organizations prioritize activities in accordance with immediate threats of survival and sustainable employability efforts may seem inappropriate in a period of downsizing in personnel.

Other key concepts of change management are stakeholder involvement, creating a vision and removing obstacles (37). Our results are in line with these key concepts, showing the importance of timely involvement of stakeholders and management vision, while concerns about changing current employment terms was an important obstacle to resolve. The financial compensation is an important reason for working in shifts. Depending on the shift schedule, financial benefits might mount up to an extra 30% on top of a shift worker’s salary. A change in working hours may imply a change in benefits, which might possibly lead to suspicion among workers about the real reasons for implementing a new shift system. Therefore shift systems fitting in current employment terms were more likely to get implemented. The process prior to implementation may not only affect the success of implementation, but also how the new shift system will be evaluated by workers. Not adequately managing the change process might lead to resistance to change. We have found a direct relationship between a positive attitude towards the new shift system intervention and improvement in health, work functioning and work-family balances after the intervention (Chapter 7). Organizations seem to be aware of the impact and complexity of implementing a new shift system and might therefore choose to focus rather on more universal sustainable employability efforts, e.g. optimizing the work environment, providing individual accommodations, enhancing communication between workers and their supervisors or delivering health promotion (42-44).

As shown in the previous paragraphs, implementing new shift systems demands major efforts, while health-effects for changing already sound ergonomic schedule are expected to be small. Nevertheless, these considerations do not imply that shift system interventions cannot be used to enhance sustainable employability of shift workers. For shift systems not adhering to ergonomic recommendations, still considerable health gains can be achieved. Several intervention studies have shown positive effects when changing from a slowly backwards rotating schedule towards a fast forward rotating schedule (38-41). The importance of morning shifts starting after 7:00h were confirmed in our multivariate analyses and we found suggestive evidence of beneficial effects on health and work functioning of incorporating a rest day before the night shift (Chapter 7). The incorporation of a rest day before the night shift might be an interesting opportunity to further fine-tune already sound ergonomic shift systems. Compared to more rigorous changes, the expected benefits of fine-tuning are probably small. However, the impact on the organization and workers will also be small and will most likely fit employment terms.
General methodological considerations

Several methodological considerations specifically for Part I and Part II have already been presented in the specific study parts. In this section, general methodological considerations concerning the operationalization of sustainable employability, the design of the project and the study sample will be discussed.

Our operationalization of sustainable employability was inspired by the definition of van der Klink et al. (45), including health and work functioning as important aspects of sustainable employability. Our outcome measures reflected short-term effects (shift-specific sleep duration and sleep quality, and need for recovery), intermediate effects (general health, fatigue and work functioning), and long-term effects (sickness absence). Some concepts may have been understudied. Work- and social-related factors have only been accounted for in three studies in this thesis. Other factors related to sustainable employability of shift workers, like personal characteristics next to age and chronotype (e.g. genetics, flexibility of sleep habits, hardiness, lifestyle and skills) (9, 46), knowledge and skills (47) and the value of work (45), have not been included. Still little is known about the relative and combined effects of irregular working times and work, personal and social characteristics. For example, work-related factors like work demands and autonomy may be equally, or even more, important than night work exposure in relation to sleep and fatigue (48, 49). Besides, like the majority of shift work studies (19), the studies in this thesis had either a cross-sectional design or a limited time frame. Both designs cannot rule out a healthy worker effect as selection into and out of shift work was taken into account (50). Moreover, sustainable employability may change and evolve with age or life phase.

The ‘Shift Your Work’ study was set-up in two parts. The results of Part I were used as a need assessment to discuss the need and possibilities to design, implement and evaluate new shift systems in Part II. As discussed in the reflections on Part II, implementing new shift systems to enhance sustainable employability deemed to be challenging. During the research period, the focus of the study shifted slightly from the design of a new shift system towards the process prior to implementation. A more pragmatic approach was chosen to evaluate five already planned shift system changes. Because four out of five shift system changes originated in changed production volumes, other contextual factors might have influenced the evaluation. For example, in Chapter 7 large differences were found in the response rate. In feedback sessions, shift workers reported that the low response rate was probably due to framing economically needed shift system interventions in sustainable employability efforts. Selection bias is likely; only those in favor or against a shift system change may find it worthwhile to participate in the effect evaluation.

Another methodological consideration is the specific study sample. Although the ‘Shift Your Work’ project had a specific focus on age, it was decided for reasons of uniformity and in close collaboration with the participating organizations to include workers of all ages. Although the age distribution of our study sample resembled that of the study population of
the organizations, targeting all workers might have caused that relatively few shift workers of 55 years and older were included. The lack of older workers in the study sample may also be due to policies “sparing” older shift workers. Most of these policies are now abandoned, meaning shift workers need to overcome the additional working years of the abandoned “sparing” policies and the increase in retirement age. Next, despite variation in companies and shift schedules, only industrial, predominantly male, workers from mostly large multinationals working in regular collective shift schedules were included in the separate studies. This implies that the results of this study are not generalizable to other sectors or shift systems. For example, the healthcare sector is characterized by female workers, working in irregular shift systems in which part-time work is more prevalent. Some studies have shown gender differences in the effects of shift work (51, 52), and also the number of work hours may affect health outcomes (44). Besides, large companies generally have more resources to facilitate sustainable employability, thereby limiting the generalizability for small to medium enterprises.

Implications and challenges for research
The implications and challenges for research deduced from the findings of this thesis are grouped in three themes. First, unresolved and emerged issues warranting further research are discussed. Second, challenges concerning pragmatic issues of work-based intervention research are discussed and alternative pathways are provided. Third, a call is made for a more integral approach when conducting shift work research.

Unresolved and emerged issues concerning sustainable employability of shift workers
- Considering the age distribution of shift workers in this thesis, many shift workers are at the verge of working past the initial early retirement age of 63 years. These additional working years are real years, due to the abolishment of all kinds of “sparing” policies for older shift workers. Little is known about the problems and needs of shift workers in these additional working years (44), demanding further research to sustainable employability of shift workers.
- A possible strategy to facilitate sustainable employability of shift workers, is to implement new shift systems. Our results support ergonomic shift scheduling recommendations, yet cut-off values (e.g. the optimum number of consecutive working days) and a prioritization in importance remain debatable. More research is needed to compare the pros and cons of different shift systems and schedules to provide more insight into the most demanding shift schedule characteristics and to come up with new innovative designs.
- New innovative designs may originate in intervening on personal characteristics, i.e. to design personalized shift systems. Individualization of shift work schedules offers the opportunity to align with chronotype, something workers intuitively do when offered the opportunity (53). A pilot of a chronotype-based schedule showed promising results
regarding sleep quality and duration, wellbeing and leisure activities (54). Further research is needed to come up with other personal characteristics next to age and chronotype (e.g. life phase or metabolic type) and to examine the long-term effects of such personalized shift systems on health, performance and social wellbeing.

- Next to the research needs regarding older shift workers, are the research needs for on-call workers. Distal on-call work is a scarcely studied but demanding working time arrangement. The use of on-call work might increase in the future due to technological developments making full shift coverage not needed anymore. More research is needed to provide insight in the effects of on-call work over time.

**Pragmatic issues of work-placed intervention research**

- There is still a lack of well-controlled studies examining the effects of shift system interventions (38, 40). A randomized control trial (RCT), the strongest research design, is often not possible due to organizational and logistic constraints. Alternative designs are available and feasible (e.g. stepped wedge, propensity scores, instrumental variables, multiple baseline design, interrupted time series, difference-in-difference and regression discontinuity) (55), allowing a more pragmatic approach, like the one used in this thesis, to meet the need for more applied shift work research.
- Applying a more pragmatic approach challenges research to align with shorter project cycles of (private) organizations compared to the usually long project-cycles in research, e.g. by having questionnaires, promotional material and an evaluation protocol available and ready to use or to use already available register data.
- Although not touched upon in this thesis, new measurement methods like wearables and data from other sources, e.g. cell phone usage, can help in gathering additional data without interrupting business processes. This kind of new technology offers opportunities for larger sample sizes and on the job assessments. However, some important ethical and privacy issues need to be resolved.

**Towards an integral approach for shift work research**

- There is a need for a more integral framework, like the one proposed by Merkus et al. (56), to disentangle working times, physical and psychosocial factors, and person-related factors. Examining the interrelations and interactions between the three domains may provide insight how actions on one domain affect the other domains and can help to develop guidelines when to intervene on which domain.
- Another important factor to include in an integral approach is time, as sustainable employability is continuous evolving through the working life. A life-course approach (57) including precise and repeated assessments of working time arrangements and health-, work- and social-related factors over time will open opportunities to better examine cause and effect and relative contributions of different domains.
Implications and challenges for practice

Six studies were conducted to examine effects of shift work and the possibilities of implementing new shift systems to enhance sustainable employability among different organizations, shift systems and persons. Several lessons for practice can be learned from our results and experiences. In this section, the implications and challenges for practice are discussed in general, as the composition of our study population does not allow us to formulate recommendations for shift workers of 55 years and older. General implications and challenges are discussed on the three levels of action to ensure sustainable employability of shift workers that were distinguished previously (58), namely the work organization, the worker and the organization. The level of the work organization refers to how work is organized, e.g. the working conditions including the shift system. On the level of the workers, implications and challenges are formulated for the individual workers, e.g. in terms of actions that individual workers can take. The organizational level covers HR-related policies and regulations, including implications and challenges for the occupational physician.

The work organization

- When non-ergonomic shift schedules are in place, implementing a new shift system may enhance sustainable employability of shift workers. We recommend to use ergonomic shift scheduling criteria and accommodate shift workers’ personal preferences as much as possible.
- Implementing a new shift system has a large impact on the organization and its workers. A careful implementation process may therefore increase the likelihood of successful implementation. For a successful implementation, we advocate based on our research and in line with other shift work experts the use of worker participation, continuous information and communication, use of champions of change, proper project management and an effect evaluation (59).
- Additional measures to ensure sustainable employability of older shift workers according to Härmä are prevention of health problems (e.g. reducing excessive work hours and night shifts) and decrease of work load (e.g. decrease of work hours) (44). A critical assessment of the production process may provide opportunities to reorganize work processes, diminishing excessive work hours and night shifts. Work hours may be decreased by facilitating part-time employment, e.g. via company, sector or national regulation.

The workers

- Sustainable employability is a joint responsibility of employee and employer. This implies that workers need to play an active role in sustaining their personal employability. From this notion we advocate the following for workers (getting) involved in shift work:
Our experience is that shift systems changes are a delicate topic for shift workers due to the possible impact on work, social life and financial compensation. Still, it is crucial to develop more knowledge on the effects that shift systems may have on the workers, to be able to address the workers’ interests and perspectives. Workers should engage in shift system pilots or experiments with an open mind and without prejudices.

In case of the introduction or a change of a new shift system, workers are encouraged to increase their knowledge of shift work and its potential impact, by actively participating in the design and implementation process, provided that the employer facilitates such participation. This would imply that shift workers organize themselves and provide input and feedback on the new shift system and its implementation. These recommendations are based on the findings (also in this thesis) that a participatory approach increases the likelihood of implementation and positive effects on health and work-related factors.

Sustainable employability depends on common worker interests, but also on personal characteristics. An important personal characteristic is chronotype. Shift workers should be aware of the impact of their chronotype on sleep and act accordingly. For instance, adjusting sleep and dietary patterns or make properly use of any freedom of choice that a shift system may offer.

The organization

If HR wants a shift system change to enhance sustainable employability, production departments should be involved in an early stage of the design and implementation process. Next to sustainable employability, gains should also be expressed in production terms, while keeping disruptions of the business process to a minimum.

We experienced that fear of losing financial benefits is an important barrier for implementing new shift systems. New shift systems fitting within the current employment terms are more likely to be implemented.

If employment terms probably need to be altered, a pilot study should first be performed in combination with a rigorous and objective effect evaluation, leaving the employment terms unchanged, to provide shift workers a better judgement of the pros and cons of a new shift system.

The occupational physician oversees all three levels of action (work organization, worker and enterprise) and holds thereby an ideal position to facilitate sustainable employability. The results of this thesis might help the occupational physician to formulate a balanced advise taking into account the effects of shift work, working circumstances and individual differences.
References

13. Koller M, Kundi M, Cervinka R. Field studies of shift work at an Austrian oil refinery. I: Health and psychoso-