Aging Workers in Industry and Retail Sector – A Holistic Approach for an Age-Related Evaluation and Design of Work

Matthias Wolf[1](✉) and Sandra Maria Siedl[2]

[1] Institute for Innovation and Industrial Management, Graz University of Technology, Graz, Austria
Matthias.wolf@tugraz.at
[2] LIT Robopsychology Lab, Johannes Kepler University Linz, Linz, Austria
sandra.siedl@jku.at

Abstract. The demographic change leads to an on average older workforce. Aging is associated with a decrease of physical abilities and an increase in physical disorders. However, guidance for the evaluation of age-critical work tasks and workplaces is needed. Using a mixed method approach, we collected data from 37 interviews with employees and management representatives and descriptively analyzed archival data sources of two large Austrian companies. Empirical findings suggest that data on different levels should be considered in analysis to derive measures that are tailored to the specific needs of industrial application.

Keywords: Demographic change · Ageing workforce · Work design · Mixed methods

1 Introduction

Demographic changes in OECD countries follows not only an average increase in the age of workers, but also lead to raised retirement ages and prolonged periods of working lives [1]. As we know from previous studies, the age of workers is negatively related to work absenteeism and productivity mainly caused by musculoskeletal disorders [2, 3]. One reason might be that the physical workload at the workplace remains constant while physical performance prerequisites decrease with increased age [4, 5].

Moreover, many industrial workers are still exposed to material handling (32% of the EU working population), repetitive movements (60%) and awkward body postures (43%) [6] which pose the health of workers at risk and promote the development of musculoskeletal disorders (MSD). In order to reduce work-related injuries or illnesses and allow for an age-appropriate task execution, a fit between the worker and the job is needed [7]. Therefore, the group of older employees in physically demanding occupations is of particular relevance in this [8].

In industry so called safety health and environmental (SHE) management systems are in place for promoting workers' health and wellbeing. As part of such management

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systems age-management combines all measures of health promotion, personnel management, work organization and work design to maintain the work and employability of all employees throughout their working lives [4].

Therefore, a resource-oriented understanding of the workability is used to analyse and optimize the interaction between human resources and the work demands [9]. Serval tools supporting age-management in industry are available in literature. On managerial level concepts like the "House of Work Ability" [10], or KPI based management model [11] can be used to explain relations and identify risk areas.

On work system level the evaluation of physical demands is at the focus of considerations and different tools to evaluate the remaining capacities and compare them with work demands have been introduced (cf. [12]). Available approaches range from stress based worker reallocation planning [13, 14], to age-based ergonomic stress assessments and workplace modifications [15, 16].

In regard to the worker itself several assessment tools for identifying human related issues e.g. the holistic and resource centred "Work Ability Index" [17] or specific assessments of remaining physical capacities with functional capacity evaluation (FCE) (e.g. [18]) are used in industry.

However, as the methods and tools summarized here are either tailored to specific industries or very generic it remains a challenge for industrial practitioners to conduct meaningful analysis and to derive concrete measures on workplace level [12]. Further an integrated management perspective and a holistic evaluation framework for businesses is still lacking [19]. This is where this paper aims to extend existing literature and management practice. The aim of this study was to identify existing challenges, critical factors at workplace level and important fields of work design in relation to an ageing workforce in the specific environment of an Austrian food retail company and fire truck producer, occupations that have been widely neglected in this research field so far. Based on a field study, a holistic picture of industry-relevant issues and requirements for work design are to be derived to assist age-appropriate work settings.

2 Case Setting and Methodology

The case study was conducted in two Austrian companies as part of a larger-scale research project from September, 2017 to June, 2020. Case company A is an international operating retail company. The divisions participating in the research project employ about 30.000 people in over 1200 stores. Case company B is an international operating producer of firefighting trucks and equipment. At 16 international production facilities about 3.600 workers are employed. To ensure comparability of these different cases the units of analysis within the companies were carefully selected.

The case study applies a mixed method approach, combining qualitative and quantitative methods. Within each company, qualitative data was collected from semi-structured interviews with representatives from management, health and safety experts, and worker. To check for convergence in the findings, qualitative data collection was accompanied by a quantitative descriptive data analysis based on archival data such as previous evaluations on physical stress and workplace ergonomics, age-structure and sick leave statistics and documented exit interviews.

Qualitative Data and Analysis Procedure
In total, 37 interviews were conducted, recorded, partly transcribed, screened and coded. We led seven interviews with management representatives including the CTO, the general HR manager and further executive staff members. Ten interviews addressed the field of industrial health and safety, more precisely involving the participation of two occupational medicines, an occupational psychologist, two work council members and five health and safety officers. Additionally, 20 blue-collar workers working agreed to be interviewed on work demands, physical limitations, health impairments in relation to work and potential improvements. Interviews took between 40 and 90 min. For data analysis, we used a code-based form of content analysis that allows to identify individual challenges and opportunities for work design.

To better understand age-specific work stress, available ergonomic workplace assessments results were aligned with the strain perceptions of participants in different age groups.

Quantitative Data and Analysis Procedure
The quantitative date gathered for this research contained statistics of sick days of 44,592 employees, sick leave data for two departments with 6,218 and 3,655 employees respectively in 2018. The data was analyzed according to the available age-structure and age-related differences. Furthermore, detailed sick leave statistics were provided by one company. This data was analyzed in a group comparison for different age groups and different reasons for sick leave, as well as a cross-department comparison normalized to age groups. In addition, 3,117 interviews in case of leaving the company were provided from the year 2017. These exit interviews results were post processed in a descriptive analysis and reasons for leave were aggregated to meaningful groups and analyzed according to a Pareto analysis to identify most relevant reasons in relation to different age groups.

3 Findings

This section provides an overview of relevant findings of the field study and the analysis of quantitative data. First the qualitative findings from the interview study are reported. Second, insights gained by comparing ergonomic assessment results in comparison with worker perception are reported. Last, results in the quantitative data analysis are provided.

3.1 Qualitative Findings for Age-Management Practice in Industry

Information Base for Age-Management
Statements made by representatives of the management and executive staff indicate limited knowledge regarding the situational awareness of age-specific issues and associated problems on the shop floor. This is illustrated by references made to the lack of related KPIs (e.g. sick leave statistics, ability limitation statics fluctuation analysis, etc.) and availability of aggregated data as a basis of decision-making. Based on a missing holistic assessment decision making is not supported by current work place assessment and

improvement procedure. Since economical disadvantages or benefits of ergonomic work design and improvements are not evaluated, the topic of maintaining worker's health and workability is only taken into consideration to the point of legal compliance. Interviewees also addressed insufficient continuous attention to age-management as opposed to daily business issues and highlighted missing resource allocation in this context.

Perception of Age Critical Work Factors
The experience gained during work life was perceived as an asset especially in terms of more complicated work tasks. Individual experience was described to be useful to lower work stress by knowing suitable techniques for work execution. Nevertheless, caused by the increasing number of physical problems of older workers most interviewees considered the elderly to be less productive. Most managers, experts and workers surveyed identified a problem for older employees in relation to physical resilience, followed by problems in specific tasks as heavy lifting, and working in strenuous postures as well as a high overall physical exertion in body movements (walking, climbing ladders, etc.). Further, environmental conditions as heat, cold, or draught were named as a stress factor, particularly by the higher age workers. Based on ergonomic assessments these factors were available at most workplaces under consideration.

Origin and Severity of Health Complaints
Interestingly, some participants linked the increasing number of physical complaints more to private reasons (sports, accidents, etc.) than to working conditions. Others reported to suffer from job-related physical complaints themselves or referred to colleagues concerned with health problems due to work tasks. Some of these persons stated that they regularly leave work with pain in different body parts originating from physical stress at their workplace. Most health issues were reported in relation to low back, knee and shoulder issues, and limitations in heavy lifting. According to the current physical state in relation to work requirements, several workers expressed the belief that they will not be able to conduct their job until reaching official retirement age.

Worker-Workplace Fit and Associated Measures
The adaption of workplaces to worker needs was perceived as an important measure to increase the possibility to reintegrate workers. In this context, improvement suggestions for age-related workplace adaptions addressing the occurrence of awkward body postures, the use of mechanical assisting devices and organizational redesign of task modifiers (layout, pieces per load carrier, lifting aids) were given as examples. Moreover, participants mentioned the extension of target times that enable individual breaks, a reduction of overall physical workload, teams as a combination of younger and older workers and individual technical support if needed can enhance a better fit between worker and workplace in relation to ageing. Workers added that means of individual support such as bandages, shoe insoles, orthoses can additionally have a positive impact on this perceived fit. Further, organizational measures (team work, division of work based on individual strengths and limitations, part time work, partial retirement etc.) were reported as suitable measures. However, as available ergonomic workplace assessment tools are not tailored to workplace requirements, nor worker age several limitations

(e.g. multi-tasking, different ability profiles, age-related or individual interpretation of results) exist for evaluating the as is situation and derive suitable measures.

Shortcomings of Current Practice
However, interviewees addressed the need for a more systematic and proactive approach for work design in relation to demographic developments taking into account changing abilities of older workers in workplace assessment and worker allocation. Incident-driven responses to a worker's physical limitations that prevent him or her from further task execution appear too narrow and reactive. This includes for example the medical evaluation of a worker's remaining physical capacities after a long-term sick leave associated with the occasion-related search for an alternative workplace. Since the number of cases where such individual solutions are needed is increasing, suitable "light duty" workplaces become harder to find.

3.2 Quantitative Date Provided by Industry Partners

Statistics of Sick Leave Days and Age-Structure Analysis
Sick leave data on aggregated level showed that 77.2% of the workforce was younger than 50 years and only 22.8% were older. However, 36% of lost days due to incapacity to work were attributed to the latter age group. For workers younger than 50 years the average value of incapacity to work days is 8.4 days per year, while it is approximately twice as long (16.3 days) for a worker aged 50 or older (overall average 10.2). It can be concluded that about a quarter of the workforce employed causes over a third of all sick days and the average amount of sick days for the older group is double the amount of the younger group. This strongly implies a need for consideration of elderly workers as a special target group.

Statistics and Reasons for Sick Leave
The subsequent analysis of the age structure for two departments with 6,218 and 3,655 employees, respectively, provides the basis for future planning. The existing age structure was quite balanced in age groups except that after the age of 50 years there are disproportionally little workers in employment (see Table 1). The forecast for the next five years indicates that the group of workers older than 50 years should slightly more than double. However, according to current numbers of employment in this age group most of these experiences workers might retire or leave the company. In relation to the sick leave statistics described in the previous section, this increases the importance of the topic of age-related work design even more for the department.

An age sensitive analysis for the data sets reported in Table 1 showed that the amount of cases per worker slightly decreases with age but the duration per case drastically increases by the threefold from the youngest (6.8 days) to the oldest age group (21.1 days). As the increase in duration outweigh the decrease in cases, the overall sick leave per 100 workers more than triples from the youngest (<24 years) to the oldest (>55 years) age group. Clearly the number of sick days per case show a high correlation with age in both departments and this tendency is in line with data reported in literature.

Table 1. Sick leave data of two departments (data provided by company)

Dep./Age	Workers		Total cases		Total sick leave days		Sick leave per 100 worker		Sick days per case	
	A	B	A	B	A	B	A	B	A	B
Till 24	1,693	1,136	1,741	774	12,251	5,286	724	465	6.8	7.0
25–34	1,451	797	1,439	645	13,419	6,451	925	809	10.0	9.3
35–44	1,335	673	1,075	594	14,556	7,251	1,090	1,077	12.2	13.5
45–54	1,401	768	1,153	750	18,169	11,569	1,297	1,506	15.4	15.8
>55 y.	538	281	469	262	10,359	5,538	1,925	1,971	21.1	22.1
Total	6,418	3,655	5,877	3,025	68,754	36,095			11.9	11.7

The data shows that there is a need for action in preventing cases of elderly workers, since they are on average more severe resulting in a longer time for recovery. A cross-department comparison shows that while the trend in sick days per case is the same in both departments (linear increase to the 3-fold, see Fig. 1 left), the amount of cases per 100 workers and age group is different. For the cases itself, the numbers show different trends for the two departments which might indicate different approaches towards the work design. As the number of sick leave cases for categories of physical complaints like musculoskeletal disorders (MSD) is related to physical overload, this variance might indicate a different approach in relation to work environment, the physical work stress, or the handling of the ageing worker.

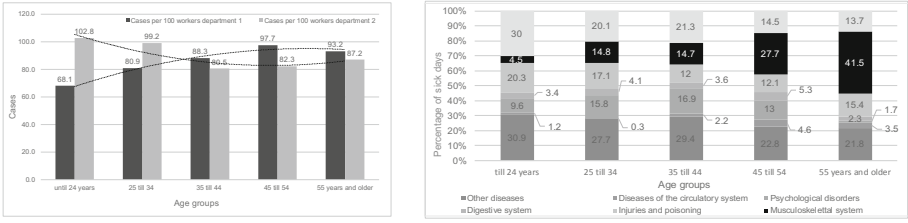

Fig. 1. Comparison of sick leave days (left) and ICF classification of cases (right) per age group (data provided by company)

Further information about sick leaves can be retained when analyzing in detail the reasons for the cases. While for the young age group, the categories of respiratory diseases and other diseases are the predominant reasons for sick leave, musculoskeletal disorders (MSD) outweigh all other reasons in higher age. For MSD the percentage of sick days steadily increases from 8.6% in the youngest to almost 40% in the oldest age group while all other types of disease show a declining, or almost constant trend. Also

the amount of cases increases from 4.7% to 32.1% for MSD (see Fig. 1 right). This implies a high relevance of physical work design in relation to an ageing workforce.

Statistics and Analysis of Company Leaves

The Pareto analysis of the exit interview data showed that out of 25 reasons covered in the survey for leaving the company the top three categories included: working hours (13%), personal reasons (11%), health and physical reasons (10%) (see Fig. 2) Thus, this data showed that the health status and physical reasons, as well as the experienced workload (5%) are main reasons to leave the job. The comparison of different age groups revealed that while the type of work is the main reason for younger employees the main reasons for older employees (>50 years) are in relation to health and physical workload. This shift in reasons for leaving the job is the same in in service job with a lower physical workload (n = 1,975) and in logistic work with a high physical workload (n = 119) as illustrated in Fig. 2.

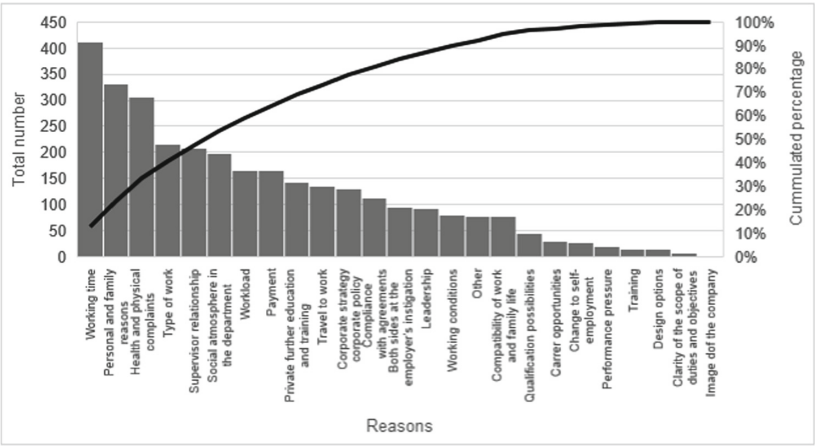

Fig. 2. Pareto analysis of reasons for leaving the company (data provided by company)

For jobs with a lower overall physical stress level, the type of work, and personal reasons are important motives for younger worker to leave their job. However, these reasons show a decline in importance with increasing age. In contrary, the workload, physical health and physical complaints are of low importance for younger workers, but increase in importance with age. As a third category, the working time is particularly relevant for the middle aged workers. In jobs with a high physical load in contrast the payment is an important reason why younger worker leave the job. With age, however, physical complaints and the climatic working conditions become highly important reason to leave. Thus for logistics jobs, health and physical complaints and the working conditions can be considered as especially relevant for elderly workers (see Fig. 3).

In conclusion the exit interviews showed that especially health and physical complaints in combination with the workload or working conditions cause elderly workers to leave their jobs. Overall the increase in health and physical complaints as a reason to

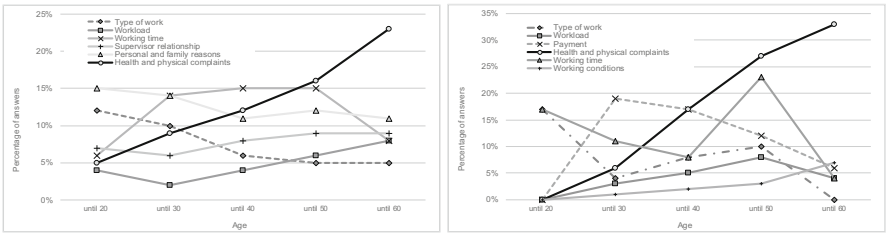

Fig. 3. Top 6 reasons for leaving the job in a department with low physical workload (left) and high physical work load (right)

leave the job stands out in comparison to all other reasons. The change in motives for leaving can be used to derive suitable incentives for workers of all age groups.

4 Conclusion

In this work a strong focus was put on incorporating outlined findings to tailor the proposed framework for work evaluation and design to industrial requirements. It can be concluded that a holistic approach of age sensitive work evaluation and design should focus on suitable KPI's to build awareness and derive management goals for the elderly workforce. Further, it should include the adaption of the workplace to the worker to minimize ability-requirement mismatches. Lastly it should focus on a participatory design process for workplace improvements. Table 2 summarizes required data, data analysis procedures and potential findings of such a holistic approach.

The conducted analysis suggests that sick leave days and reasons for sick leave in combination with an age structure analysis can help to identify age-related problems in physical work. Broken down on different departments, or in comparison with an industry benchmark fields of action can be identified. Specifically, a root cause analysis of sick leave statistics per department can support the understanding of these differences. In addition, the qualitative investigation into the workforce perception can provide information about existing issues, challenges and improvement suggestions. This data can further be supported by quantitative finding as the analysis of exit interviews. However, measuring impact of changes by relating it back to the defined goal is key to achieve long term improvements.

The mixed methods approach applied in this research enables to draw a holistic picture of challenges, and opportunities for an ageing workforce in industry and retail. These findings that extend existing literature by industry specific age-critical work requirements and possible counteractions in the field of heavy machinery production and retail, an industry field that had been largely neglected in literature so far. The framework assists in building awareness and provides a starting point to support industrial practitioners in implementing age appropriate work settings.

Table 2. Data for age-based work evaluation basis for work design

Domain	Data to consider	Data analysis procedures	Potential findings
KPI's for goal setting	Employee list including age, seniority, work schedule and workplace	Age structure analysis Cross department comparison	• Identification of old/imbalanced areas • Need for action related to age
	Aggregated or individual sick leave statistics on employee base and department level	Group comparison for different age groups Comparison of reasons for sick leave/job attendance Cross-department comparison normalized to age groups Benchmark with similar industries	• Building awareness on the as-is situation • Need for action according to health issues • Identification of problem areas for older workers based on sick leave
	Worker fluctuation data and exit interviews	Descriptive statistics Pareto analysis Age group comparison	• Reasons for leaving the job including potential fields for action
Worker workplace mismatches	Worker surveys to detect physical (dis)abilities and high work stress (physical and mental)	Department and age-group comparison for: Work ability (e.g. WAI) Ability limitations (e.g. FCE) Subjective complaints (e.g. Nordic questionnaire) Perceived strain from work (e.g. grading scales)	• Reduced work capacity (work years/financially) • Physical complaints in relation to work • Perception of work in relation to workability
	Ergonomic evaluation of workplaces	Ergonomic assessment with suitable tools(e.g. KIM, EAWS) in workplace observation interviews	• Identification of workplaces with high risk ratings
	Interview study on expert and worker level	Structured content analysis	• Worker needs • Possible improvements
Measures	Other sources (Certificates, health promotion information, etc.)	Structured content analysis	• Overview of solutions offered for older worker in the company
	Participatory process for work improvement	Creativity techniques	• Idea generation for individual measures that are accepted by workers

All in all, the intention was to propose a first version of a framework that considers age aspects in work analysis and design by linking the experiences from the industrial case study to relevant research. Further research should be conducted based on mixed method case study approaches to obtain deeper insights in the connections of age, health and workability in relation to physical work stress during the working life.

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