



Work in Progress: Barriers and Concerns of Elderly Workers Towards the Digital Transformation of Work

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Abstract. Digital transformation of work is in progress and will force employees to focus on computer related competences, training and flexibility. In addition, elderly workers are less experienced and slightly less efficient in training, will play a key role for labour markets in the near future due to demographic change. To understand elderly workers needs and to further guide this transformation process, this article focuses elderly workers concerns and barriers about the digital transformation at work. In a first step, we could identify user, technology, and context related factors of importance, such as working effort, lack of competence, unclear responsibility, fear of unemployment, compromised work-life balance, insufficient legal foundation, changing habits, and lack of support in the company. In a second step, we found that elderly workers are most concerned about changing habits, but nevertheless, concern ratings were not high. These results show that it is of high importance to consider employees needs during the digital transformation of work. Results were discussed in order to provide validated instructions on how to supervise and encourage digital transformation, and how to ensure participation of less technology enthusiastic workers.

Keywords: Digital transformation · Future of work · Age · Mixed-method

1 Introduction

The digital transformation of work is in progress, but still, this process is mostly researched by technicians or engineers who aim to optimize technical or economical parameters like efficiency, effectiveness or costs. Nevertheless, since this transformation is a manifold process involving technical innovations (e.g. big data, cloud integration, artificial intelligence, decision support systems etc.) as well as political, economical and social transitions, it is important to understand every shareholder's perspective (i.e. politicians, employers and employees) to ensure societal integrity. Especially elderly workers play a key role in this transformation process for several reasons: First of all, they started to work

in pre-digital environments and—even if digital transformation is different from previous industrial revolutions—they possess a very experienced perspective and a very elaborated viewpoint on technological change in general. Secondly, they have different needs in terms of technology acceptance [1], making them harder to address by technology developers, and thirdly, industrial countries perform a demographic change, which makes elderly workers the largest working group in the near future. Because the digital transformation of work might profit considerably from understanding their perspective and needs, we aim to identify and validate concerns and barriers using a two-step mixed method approach and conducted two mixed-aged focus groups, followed by an quantitative online survey with an elderly sample.

The outline of this article is as follows: In Sect. 2, we provide an overview about the digital transformation of work (Sect. 2.1), and the domain of elderly workers (Sect. 2.2). In Sect. 3, we describe the method of our focus group study (Sect. 3.1), as well as the results from qualitative content analysis (Sect. 3.2). Correspondingly, we describe method (Sect. 4.1) and results (Sect. 4.2) of our elderly-sampled questionnaire study in Sect. 4. We discuss the results of both studies in Sect. 5, deliberate limitations of our methodology in Sect. 6 and summarize our contribution in Sect. 7.

2 Related Work

2.1 Digital Transformation of Work

The digital transformation of work is an extensive and irreversible process that will change the future of employment tremendously on several dimensions. We use the terms *digitization*, *digitalization* and *digital transformation* according to [2]: Digitization is the process of making analogue information digital, digitalization the use of digital information in applications and digital transformation the process of increasing interconnection of digital data and processes.

What does it mean for employees? While in the classical analogue industrial employment system—that might be digitalized, but not yet transformed—the employees fulfilled narrowly defined jobs in an office that is provided by the employer, while being part of a strictly hierarchical decision-making process. The digital employments system provides project-based working, is independent from location, and decision making takes place in teams with flat hierarchies. Furthermore, this shift put an emphasis on workers knowledge, training, skill and intellectual property, while making borders between firms permeable: Workers are hired for shorter tenures, and are instead expected to move horizontally from company to company, rather than climbing a vertical job ladder [3]. However, this is not even the final form of the transformation, since recent developments broke work down into smaller parts than projects, such as clickwork (e.g. tagging items on a website), or crowdwork [4], where smartphone apps are deploying single tasks (e.g. driving) [5]. When considering that—despite the huge potential on digital transformation on wellbeing—most of these new crowdwork jobs are

precarious, the need to guide this process becomes a key challenge to retain societal integrity.

Digital transformation of work affects the whole nature of work, it re-shapes established job-roles and workforce-skills; workers have to acquire basic computer skills to be able to interact in a digitalized working environment, and have to develop data-related skills like data monitoring, analysis, and diagnostics, while machinery operation and physical strength will be of decreasing importance [6]. The demand of labour power is shifting towards a competence profile of employees that focusses computer skills as well as creativity and interpersonal skills [7]. Even though concerns about *technological unemployment* are not novel, and technological development had always led to an increase in wealth in intermediate-term, it is important to take employees concerns seriously [6], especially since machines are not just getting stronger, but are also getting artificially intelligent [8].

2.2 Elderly People at Work

Elderly workers are of increasing importance for companies since demographic structures are changing in form of falling birth rates and longer life spans, which leads to an increased median age of workers and an increased proportion of elderly workers in the labour force [9], especially in economically developed countries [10]. However, the process of aging is multidirectional and multidimensional, and its influence of task performance is quite extensively discussed in research: According to a meta-analysis [11] (380 studies), age was not related to core task performance and creativity, but positively associated to social and safety behaviour (e.g. helping co-workers resp. complying with safety rules). Furthermore, age was negatively related to counterproductive work behaviors, but the performance in training programs was found to be slightly lower in elderly workers. In contrast to these empirical findings, stereotypes against older workers are quite persistent: They are considered less adaptable, more costly, at higher health risk, less energetic, and disinterested in training [12].

As a consequence, companies are advised to develop a learning and aging friendly climate, encourage knowledge transfer and provide physical as well as psychological health practices [13]. In addition, aging employees are advised to utilize current strengths and abilities at best and behave proactive in terms of enquiring feedback, altering the view of the job, as well as defeating stereotypes [14], which are otherwise internalized and replicated [15].

In summary, digital transformation is not yet finished and is already putting an emphasis on lifelong learning, especially in computer-related domains. In addition, older workers will be the biggest working group in the labour market and might not have developed those skills yet. Furthermore, working tasks may change to an extent that elderly workers might not benefit from their experience anymore, but are instead suffering under slightly worse learning abilities and unfounded stereotypes. To understand elderly workers concerns and barriers when dealing with digital technology in working context is therefor essential to guide the digital transformation of work.

3 First Study: Exploratory Identification of Relevant Factors

As an initial step into the domain, we conducted two explorative focus groups to get qualitative insights.

3.1 Method

Focus Group Design and Sample Description. Both focus groups were designed as semi-structured guideline-based interviews and had the same moderator to keep experimenter artifacts consistent [16]. The whole session was designed to last about 60 min, and despite snacks and beverages there was no monetary compensation, all participants volunteered. The guideline was divided in 4 sections. Section 1 was about the status quo of digital transformation of the subjects work environment, Sect. 2 about the increasing digitization in general, Sect. 3 about specific challenges, barriers and concerns, and Sect. 4 was designed as mind mapping task to make the participants recap the session. To prevent participants from repeating stereotypes, age factors were not explicitly mentioned in the guideline, but unknowingly to them, two members of the group were deliberately sampled to be older than 50. Both groups automatically discussed the topic of elderly workers.

In addition, all subjects were sampled to be employees and both groups were composed to have equally represented gender and work experience. Overall, $n=7$ volunteers (3 female), aged from 24 to 58 ($M = 38.14$, $SD = 15.5$) could be recruited to take part in our focus groups. Both focus groups were held in German language.

Analysis Procedure. To keep the analysis as objective and reliable as possible, we used a consensual approach of thematic qualitative content analysis [17]. The recordings of the two focus groups were transcribed in accordance to the GAT2 standard [18]. As initial step into the analysis, we defined two main categories deductively: *Usage Barriers and Concerns*, and *Factors of Age*. We used our transcriptions as sampling units, the participants contribution to the discussion as recording unit, a single phrase as smallest possible content unit, and a whole coherent statement as context unit.

The whole material was assigned into the two main categories by four experienced coders independently, while memos and headings were written into the material, complying with the *open coding* approach [19] and the guidelines defined in [20]). Inductive sub-categories were developed subsequently. The final consensual category system was elaborated by combining the four independent approaches among several coder-meetings. The final result is unanimous and inter-coder reliable. Anchor examples are translated into English language for Sect. 3.2.

3.2 Qualitative Results

In this section, we report the results of two focus groups. We identified 81 content units and assigned them into 17 sub-categories that were developed inductively.

Main Category 1: Usage Barriers and Concerns. The first main category contains usage barriers towards the digital technology in professional domains. Our content units could be assigned into three sub-categories: *Technology Factors*, *User Factors*, and *Context Factors*.

Technology Factors. This category contains arguments that were related to digital technology itself. Among these content units, we could furthermore derive two sub-sections: *Working Effort is not Decreasing, but Increasing*, and *IT Security is not Sufficient*.

Working Effort Is not Decreasing, but Increasing. Subjects stated in various cases that the use of digital technology led to more working effort and therefore not to an increase in efficiency. According to our subjects, this is mostly related to poor usability design (“If a customer wants to buy three things, I have to open his account three times and he leaves the shop with three separate slips of paper.”) or insufficient scope of functions.

IT Security Is not Sufficient. One participant argued that she wants to use free third party software at work, but she is not allowed to because sufficient IT security could not be granted. Others stated that cybercrime is already a huge threat to the company: “I was advised to pull out all plugs immediately when a specific notification shows up. Otherwise, the company could be forced to close the doors for several months.”.

User Factors. This second sub-category contains factors that are quite essential to the research question: User Factors. Among all arguments that contained indicators for transformation of work being delayed for reasons of users barriers or fears, we could examine five sub-categories: *Lack of Competence*, *Who is Responsible?*, and *Fear of Unemployment, Unbalanced Work-Life Balance*.

Lack of Competence. Participants often argued that a lack of competence is a barrier to deal with. On the one hand, they argued that they “have to deal with more and more information”, as well as they need “domain knowledge AND the knowledge about the technology”. On the other hand, two participants argued that some workers underestimate the autonomy of analogue work, because some jobs can not be done anymore if services out of reach (e.g. servers) are down. The topic of apprenticeship and schooling was discussed quite controversially, since some subjects stated that there is an urgent need for more digital content, while others argued that some educational material is already digital, but shouldn’t be.

Who Is Responsible? Subjects often stated that the question of responsibility is still unsolved. The representation of relevant content on a display might lead to a “responsibility-shift from worker to machine”. Users fear to carry not only the responsibility for their actions and decisions, but in addition the responsibility for the maintenance of hardware. Workers often feel urged to give up responsibility, because otherwise they would not be able to work, but on the other hand they would be “made responsible” for faulty technology.

Fear of Unemployment. Some content units contained arguments that reflected the fear of being substituted by technology. Besides “the fact that there is the potential for substitution”, participants also minded that “the whole process is driven by short-term improvement of costs instead of human-centered transformation”.

Unbalanced Work-Life Balance. When talking about the possibility to work independently from time and location, our subjects stated that it is already a challenge to remain work and life well balanced. Underlying factors were the uncomfortable feeling to be contactable at all time, and the fear of not getting a promotion if taking too much off-time. One participant stated that “it could be positive to be able to work all the time, but i don’t want to be obliged to.”.

Context Factors. The third sub-category adresses the basic conditions that were mandatory to workers: *Legal Foundation*, and *Support in the Company*.

Legal Foundation. Several participants argued that the actual legal foundation fails to cover the possibilities of a digitally transformed world of employment. Legally limited working times might not be sufficient for projects, even if there is enough off-time as compensation. On the other hand, according to our sample, there is not enough worker protection for newly created jobs like clickworkers. Furthermore, workers in jobs with an increasing amount of sensor information often suffer from regulations from pre-digital area, since they “have to write documentations until they are completely exhausted”.

Lack of Support in the Company. Furthermore, subjects identified co-workers or even managers as unsupportive and overcautious in processes of change: “employees use what they are instructed to, but higher levels fear that something goes wrong”. In addition, one participant even said that “there are smaller fights from time to time to convince people of technological development”.

Main Category 2: Factors of Age. The second main category contains factors that were directly related to workers’ age. We could identify *Younger Workers in Disadvantage* and *Elderly People in Disadvantage* as sub-categories. We could furthermore identify two content units that were relevant for our research question, but could not be covered by any of the other categories. We report those as *Additional Findings*.

Younger Workers in Disadvantage. Participants stated that especially younger workers are disadvantaged if technology fails, because they are less experienced in working without technology. Furthermore, one subject argued that “younger workers often struggle to combine classic work with the technical component”.

Elderly Worker in Disadvantage. When discussing the topic of elderly workers, participants argued that those workers are often overcharged by digital technology. Underlying factors were inexperience, because they are just not “grown up” with technology, or they are just not considered by technology designers to cope with e.g. visual impairment. In addition it was reported that especially elderly workers struggle to change their habits.

Additional Findings. One of the elder subjects argued that she is not at all concerned about digital transformation because she had no problems with technological progress at work during the last decades. Another subject argued that especially older and more experienced workers are expected to suggest ideas about digital transformation, even if they are less experienced in the use of technology.

4 Second Study: Evaluation with Elderly Sample

To further evaluate our results from the first study (Sect. 3), we conducted a quantitative online survey as a follow up.

4.1 Method

Survey Design and Variables. The survey was designed to have a completion time of 15 min. As demographic data we measured gender, age, highest education degree and self-efficacy towards technology (SET) [21]. As dependent variables we measured the barriers and concerns from the first study by asking a single 6-point likert-item per concern/barrier. The ascertained variables reflected *Habits*, *Competence*, *Effort*, *Age*, *Unemployment*, *Work-Life Balance*, *Responsibility*, *Legal Foundation*, and *Support*. The wording of the items was chosen accordingly to the results from study 1, e.g. “When thinking about the digital transformation of my job, I am concerned that the usage of digital work equipment leads to higher effort for me, because the application is not easy to use.” for the variable *Effort*. All likert items were measured on a scale from 0 (“strongly disagree”) to 5 (“strongly agree”).

Sample Description. Overall, $n = 239$ participants (49% female) completed the survey. Age was ranged from 50 to 66 years ($M = 56.31$, $SD = 4.45$). 34.7% of our sample completed lower secondary school, 36.4% secondary school, and 24.9% had a high school diploma. SET was ranged from 0.5 to 3.5 ($M = 2.33$, $SD = 0.65$, $\alpha = 0.85$) on a scale from 0 to 5. All participants were recruited via an online panel and got a small monetary incentive in return.

4.2 Results

Descriptive Statistics. Table 1 shows the descriptive statistics of our dependent variables. Every single items covered the whole theoretical range from 0 to 5. Surprisingly, concerns about habits were rated the highest ($M = 2.35, SD = 1.57$), while concerns about insufficient legal foundation remained the lowest ($M = 0.78, SD = 1.19$). Concerns about the own competences ($M = 1.87, SD = 1.53$) resulted in the same (rounded) mean value as concerns about age ($M = 1.87, SD = 1.58$), while the worry about increasing effort remained slightly lower ($M = 1.81, SD = 1.42$). Furthermore, the fear to be unemployed resulted in a mean value of $M = 1.52$ ($SD = 1.47$), slightly above the concern of unsure responsibility ($M = 0.98, SD = 1.31$), impaired Work-Life Balance ($M = 0.98, SD = 1.31$) and insufficient support by co-workers or management ($M = 0.93, SD = 1.21$).

Table 1. Descriptive statistics of measured concerns and barriers.

	Min	Max	Md	M	SD
Habits	0	5	2	2.35	1.57
Competence	0	5	2	1.87	1.53
Effort	0	5	2	1.81	1.42
Age	0	5	2	1.87	1.58
Unemployment	0	5	1	1.52	1.47
Work/Life-Balance	0	5	0	0.98	1.31
Responsibility	0	5	0	0.98	1.33
Legal Foundation	0	5	0	0.78	1.19
Support	0	5	0	0.93	1.21

Note: Order of rows was chosen according to Diagram 1.

Figure 1 shows the likert plot of the same results. Overall, its rather visible that concerns and barriers are more frequently disagreed than agreed on. Even the most agreed concern, that habits need to be adapted to digital technology, is slightly more often declined (51%) than affirmed.

4.3 Evaluations of Barriers

As could be seen in the previous chapter, concerns and barriers were not that severe in terms of absolute agreement. When considering correlations (Table 2), it can be shown that within our elderly sample, the concern to get unemployed for reasons of digital transformation decreases with age ($R = -.15^*, p < .05$). Furthermore, higher SET is associated with lower fear to be left behind by younger coworkers ($R = -.16^*, p < .05$). Gender (dummy-coded) is as well

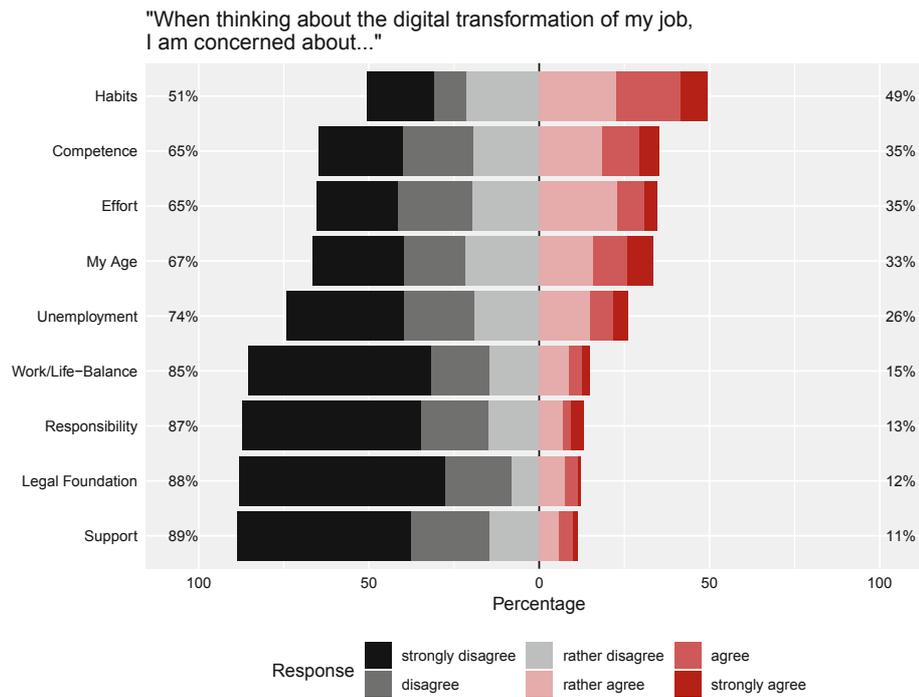


Fig. 1. View of the subject; 2 pillars are out of sight.

correlated to the concern to get unemployed ($R = .19^{**}, p < .01$), the concern of impaired work-life balance ($R = .18^{**}, p < .01$), and lack of legal circumstances ($R = .16^{**}, p < .01$), all with men being more afraid. All three results can be covered by inferential statistics (Mann-Whitney U-Test): Elderly men are more afraid to lose their jobs ($U = 5371.5^{***}, p < .001$), more afraid that their work-life balance gets impaired ($U = 5534.5^{***}, p < .001$), and more concerned that legal foundation fails to cover their needs ($U = 5753.5^{***}, p < .01$). Furthermore, all barriers/concerns are heavily intercorrelated.

5 Discussion

According to our qualitative results, we could replicate some of the previous findings: Workers are concerned about being substituted by technology, are aware of the importance of training and development of data related competences, and consider elderly workers to be less flexible. Surprisingly, we found a gender difference regarding the fear of unemployment with men being more afraid. This might result from different working domains, since men of our sample (recall: age was 50+) might work in more technology driven or even physical strength requiring domains. However, the underlying factor is not sufficiently explored, yet important. In addition to that, we could identify indications that current working technology lacks of usability, which is rendering the desired increase in productivity void. Following that argument, its important to consider the hitherto underrated role of software developers and highly usable products for the digital transformation as well. This is also covered by the finding, that elderly people need to be specifically addressed in terms of e.g. visual impairment.

Table 2. Significant Spearman-Correlation for age, gender, SET and concerns/barriers.

	Age	Support	Habits	Legal Foundation	Work/Life-Balance	Unemployment	Responsibility	Competence	Effort
age									
gender				.16*	.18**	-.15*			
SET	-.16*								
Age	—	.55***	.35***	.18***	.27***	.31***	.41***	.38***	.46***
Support		—	.28***	.46***	.47***	.57***	.68***	.45***	.47***
Infrastructure			—	.31***	.41***	.45***	.35***	.65***	.61***
Legal Foundation				—	.71***	.45***	.48***	.37***	.41***
Work/Life-Balance					—	.47***	.49***	.52***	.51***
Unemployment						—	.61***	.51***	.44***
Responsibility							—	.51***	.46***
Competence								—	.69***
Effort									—

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. Gender is dummy-coded: female = 1, male = 2.

The fear to changing habits was rated as the highest concern about digital transformation, which leads us to the conclusion that future training programs should not only foster technical skills, but also flexibility and iterative improvement and adaption of routines. This becomes a key challenge, especially since elderly workers are slightly less effective in training programs, less experienced in the use of technology and are also facing stereotypes according their flexibility. Nevertheless, the concerns were slightly negated in absolute benchmarks, indicating that elderly workers are not only experienced in their domain, but are also experienced in the domain of change, which might include digitization. This is also covered by the qualitative results: Elderly workers are not overly-worried in general, yet underlying factors are not explored sufficiently; we were not able to find a factor that explains inter-individual differences. Future work should address the role of habits on well-being and productivity at work, particularly in the context of computer-related skills, as well as the influence of human factors, such as demography, specific work experience and personality.

6 Limitations

As mentioned in Sect. 3.1, our guideline design was not specifically mentioning age factors to avoid the problem of stereotype replication vs. experience based result. We consider this a valid approach, but especially qualitative designs are very vulnerable in terms of guideline topics and moderator behaviour. Future studies should triangulate our results by choosing a different approach, e.g. by letting the subjects discuss purposely aging stereotypes, or by conducting focus groups with an all-young or all-old sample. Furthermore, our quantitative design is based on the analysis of single items, which is not only sensitive to response biases, but also prohibits parametric analysis. Our second study aims to give a

first insight into the topic of concern priority, but these important concerns need to be operationalized into reflective or even formative self-reporting scales for future studies. In addition, we found legal foundations to be of surprisingly low importance in the quantitative results, which might not be transferable to other industrial nations, because the attitude towards legislature might differ among cultures.

7 Conclusion

Since digital transformation of work is in progress and elderly people play a key role for the labour market in the near future, we conducted two exploratory studies—an to examine elderly workers concerns and barriers when dealing with digital technology at work. In our first study, we examined technology, user and context related factors that were of relevance to elderly workers. Our subjects stated that the use of digital technology leads to an increased working effort, while furthermore essential technological competences are not sufficiently developed or educated. Furthermore, the question of responsibility, the fear of unemployment and an impaired work-life balance were topics of high importance, along with insufficient legal foundation, lack of support in the company, and the need to change habits. The need to change habits was found to be rated higher than the other concerns, while the fear of impaired work-life balance, the question of responsibility, while insufficient legal foundation and company support were predominantly negated. This result shows that companies should further focus on training programs and reduction of stereotypes. Furthermore, we found a significant gender difference in men being more concerned about unemployment, work-life balance and legal foundation than women. Future studies should investigate underlying factors to consider user-diversity in training programs.

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