Challenges and Opportunities of Digitalization for Health and Well-Being at Work – Results

from a Mixed-Methods Cross-Sectional Study from Austria

Birgit Teufer, MA[1], Dr. Gert Lang[2], Lisa Affengruber, MSc[1], and Mag. Ludwig Grillich[1]

[1] Department for Evidence-based Medicine and Evaluation, University for Continuing Education Krems,

Austria

[2] Austrian Health Promotion Fund, Austrian National Public Health Institute, Vienna, Austria

Citation:

Correspondence address

Birgit Teufer https://orcid.org/0000-0002-3324-0639

Department for Evidence-based Medicine and Evaluation

University for Continuing Education Krems

Dr. Karl Dorrek-Straße 30, 3500 Krems, Austria

birgit.teufer@fh-krems.ac.at

Abstract

Objectives: Digitalization, flexibilization, boundaryless work, participation, and meaningfulness are characteristics of new ways of work ("Work 4.0") and have an effect on the health and well-being of employees. For workplace health promotion (WHP) measures to be effective, companies must know what challenges they face or what opportunities are available. The present study examines challenges and opportunities of digitalization for health and well-being at work, interrelations with key aspects of Work 4.0, and differences between companies. *Methods:* We chose a mixed-methods approach and followed 20 companies along a WHP project management cycle. We conducted semistructured group interviews, document analyses of the developed WHP catalogs of measures, and an online survey to quantify and validate the results. *Results:* We identified challenges and opportunities for health and well-being at work resulting from Work 4.0. The main challenges were the sensitization of managers and the constant availability of employees as a health risk; the main opportunities were the optimization of knowledge transfer, communication processes, documentation, and work information materials. The companies surveyed were similar in most outcomes, only two opportunities varied in relevance across companies. Regarding the key aspects of Work 4.0, only "participation" was associated with some of the identified opportunities. *Conclusions:* Companies can benefit from addressing Work 4.0 and health and well-being at work together. To realize meaningful and target-oriented solutions, companies should identify the challenges and opportunities perceived as most important before implementing measures. Considering these basic principles, WHP can support the digital transformation change that companies face today.

Keywords: workplace health promotion, Work 4.0, new ways of work, digital transformation change, mixed-methods

Background

In recent years, an accelerated change in the way we work and related working conditions can be experienced. Digitalization is occurring in all areas and spheres of life (1) with far-reaching changes for entire social and economic structures (2), affecting companies, the labor market, and occupational profiles (3). This so-called "4th Industrial Revolution, "Work 4.0" or "New Ways of Work" (NWW) is likely to have major impacts on work itself and on the work-associated demands on the workforce.

Poethke and colleagues identified several central features of NWW (4). The core aspect of NWW is digitalization due to the increasing cross-sectoral use of and dependence on modern information and communication technologies (5). Another characteristic of NWW is the flexibilization of work (6) with several aspects, including spatial in terms of the (free) choice of workplace, or temporal in terms of the organization of working time (1). Flexibility in these areas is often combined with agility in project work and greater personal responsibility of the employees (4). In addition, one can observe the phenomenon of "boundaryless work". This includes the increasing shifting of boundaries between work and private life (1, 7) with regard to space, time, work equipment, content, quality, organization, sense of meaning, and motivation. The aforementioned formal and structural changes in working conditions often lead to a change in employees' attitudes towards work. This is accompanied by a growing need for participation, that is, to be actively involved and have a say in company decisions, and to be consulted, for example, in the context of internal health policy (8, 9). Finally, NWW leads to an increased need to pursue a work activity that has purpose, the so-called meaningfulness of work. Good work or the quality of work is measured by whether the work has a personal or social meaning, and whether is subjectively considered meaningful and relevant (10).

These NWW features have an effect on employees' health and well-being (11, 12). They generate new work demands, such as work intensification, intensified planning and decision-making requirements, and increased learning demands (1). There are numerous recent studies on the health-related effects of NWW dealing with occupational health and safety (13-15), work–family balance (16),

mental health (11, 17), and many more. A recent systematic review showed the psychological impact of the NWW, which, in addition to positive aspects such as increased workers' engagement, brings with it negative aspects such as fatigue and mental demands (18). Depending on the socioeconomic position and situation, the health-related risks of NWW are uniquely distributed (19). Thus, NWW is associated with the risk of growing social inequalities (15), with the highest risk of direct and indirect negative health effects on the side of low- and unskilled workers (20).

As health-related effects and well-being are multicausal, and social, economic, cultural, or labor policy factors determine how digitalization is used (2), it is important to recognize NWW as a social and thus a design object at the company level. Therefore, digitalization can support preserving employment opportunities and improve working conditions. Under certain conditions, it can be ensured that the changes enabled by digitalization will serve people's well-being or the humanization of work in the long term (21). Consequently, the introduction and use of digital technologies should never be solely technology-centered, but rather should be complementary, accounting for the interdependence of technological, organizational, and work dimensions (2).

In the course of the introduction and implementation process of human-oriented forms of work, the holistic health promotion (HP) approach has proved useful. HP refers to the process of involving and empowering people to increase their control over the determinants of health and well-being. Health is understood as a positive, holistic, and dynamic concept and includes physical, psychological, and social well-being. HP should not only consider individual health behavior, but especially so-called health determinants, for example, the social, cultural, or economic health conditions (22).

According to the HP approach, health is established in the context of everyday life. The central field of action of the HP approach thus includes the creation of health-promoting work conditions in the workplace setting (workplace health promotion, WHP) (23). Several recent systematic reviews have demonstrated the effectiveness of WHP, especially when comprehensive, multimodal, and holistic WHP programs are implemented at the relationship and behavioral levels (24-29). A recent meta-analysis

found that WHP measures can contribute to greater effectiveness with target groups from lower socioeconomic positions, for example, if they were specifically designed for these groups and included them in the development and implementation (30).

WHP can therefore play a decisive role in preparing employees and companies for new developments in the world of work. However, for WHP measures to be effective, it is necessary to know the challenges one needs to tackle or the opportunities one wants to take. To the best of our knowledge, there is currently little literature on the challenges and opportunities (C&O) that NWW brings to health and well-being at work.

The Austrian Health Promotion Fund has recognized this gap and has supported 20 Austrian companies in the implementation of projects focusing on "WHP in the Working World 4.0: Digitalization and Fair Health Opportunities", taking into account the basic principles of WHP (31). Accompanying research was commissioned to evaluate the implementation and to establish a good basis for the development of WHP measures.

Against this background, the present study examines the question of how WHP can react appropriately to digital transformation change by studying the C&O caused by NWW.

Methods

We followed 20 companies from ten business sectors and with different company sizes along a WHP project management cycle to identify the C&O of digitalization for health and well-being at work that companies must face. For detailed company and project descriptions, please see Lang (32).

We chose a combination of different qualitative and quantitative research methods and instruments. As a first step in this multistage process, we conducted open-result, qualitative, semistructured group interviews (33) with the WHP project leaders in the first half of the project period.

The group interviews took place on different dates in two cities in Austria. A total of 24 people (fifteen and nine participants, respectively) participated; some companies had a shared project management and were represented by two people from the project team. Two companies were unable

to attend the group interviews and were subsequently interviewed on the respective issues by

telephone. We prepared an interview guide based on the research questions. At the beginning of the

group interviews, we presented the evaluation project. We applied various visualization and moderation

techniques (e.g., scales on flipchart papers or the use of moderation cards) for answering the prepared

questions. All answers given visually and/or in writing were then discussed in the group. Discussions

were explicitly desired; there was no predetermined order of speakers. The first author of this paper

moderated the group interviews and ensured that all participants were involved. We documented the

interviews via notes and photo protocol of the flipcharts. Since we did not see any benefit in a literal

recording, transcription, and evaluation of the given answers, we refrained from doing so for reasons of

cost efficiency.

We carried out the subsequent document analysis based on the catalogs of measures designed

by the participating companies. We assumed that behind every developed measure there is a

corresponding challenge that a company wants to meet or an opportunity that one wants to use with

this measure. The companies received a template from the funding authority for the design of the

catalogs of measures and had to provide various information on the planned measures, including name

and content description of the measures. We evaluated the catalogs of measures using content analysis

(34). One of the team researchers initially coded and categorized the catalogs of measures and discussed

the results with a second person. In this first step, we worked purely inductively, that is, the categories

were created from the data without any external input. In a second step, we synthesized the notes from

the group interviews and the categories from the catalogs of measures and extended the existing

category scheme as required.

To quantify and validate these results, we contacted the project leaders by e-mail and asked

them to distribute the link for our online survey to the remaining project team members. After an

introductory explanation and questions on demographic variables, the C&O presented by digitalization,

which we gained from the group interviews and document analyses, were given. Participants indicated

whether the particular challenge or opportunity had emerged in their organization and how important

they considered it on a 4-point answer scale from "very important" to "completely unimportant." We

instructed the participants to choose the option "completely unimportant" if a challenge or opportunity

did not occur in the respective company. Afterwards, the participants had the opportunity to list further

C&O and to indicate their importance on the same scale. Following this, we used the German-language

"Measurement Instrument for the Assessment of Central Aspects of the NWW" (4), which employs 25

items, to capture the dimensions of the digitalization of work processes, the increasing flexibility of work,

boundaryless work, as well as the possibility of participation at work and its subjective meaningfulness.

The participants answered the items on a 5-level scale from "completely correct" to "not correct at all"

(4). Only the German version was used during the research. The authors of the questionnaire also

provide an English translation (35), which we used for the wording and description in this article. To give

the readers of this article a general idea of the questionnaire's contents, we provide example items in

the appendix (Supplementary Table S1). Information about reliability data can be found in the results

section (Table 4 and following text). We used the online survey tool LimeSurvey (36).

In the online survey, 71 people from nineteen companies, aged from 22 to 59 years (mean 42

years, SD 10.1 years), answered several questions. We received feedback from very few companies as to

how many people the questionnaire was forwarded to. Therefore, we are unfortunately unable to

calculate a response rate. Table 1 shows the company characteristics of the participating enterprises and

the basic characteristics of the participants in the online survey.

Table 1

Sample Description

Participating Companies		
Company characteristics	Distribution of participating	in % (n)
	companies	100% (20)

Business sector	Health and social services	40% (8)
	Manufacture of goods	10% (2)
	Hotel and restaurant	10% (2)
	Public administration	10% (2)
	Arts, entertainment, recreation	5% (1)
	Transport and storage	5% (1)
	Education and teaching	5% (1)
	Financial and insurance services	5% (1)
	Provision of other services	5% (1)
	Provision of other economic services	5% (1)
Company size [a]	Small enterprise	10% (2)
	Medium enterprise	50% (10)
	Large enterprise	40% (8)

Participants Online Survey

Demographic variable	Answers	in % (n)
Total		100% (71)
Gender	Female	93.0% (66)
	Male	7.0% (5)
Age	Up to 30	15.5% (11)
	31–40	33.8% (24)
	41–50	26.8% (19)
	51 and over	23.9% (17)
Extent of employment	38.5 hours/week or more	46.5% (33)
	20–38 hours/week	46.5% (33)
	Less than 20 hours/week	5.6% (4)
	Yes	36.6% (26)
	No	63.4% (45)

Childcare

responsibilities for

children under 12

Management	Yes	45.1% (32)
responsibility	No	49.3% (35)
Role in the project team	Project Management	31.0% (22)
(multiple selections	Employee Representatives	11.3% (8)
possible)	Workers' Council	14.1% (10)
	Representatives	54.9% (39)
	Other	

Note. N companies = 20; N Participants online survey = 71. If the n do not add up to 71, there were

missing data and the valid % are reported. Age was entered in a free-text field; therefore, the calculation

of a mean value was possible.

[a] Small enterprise < 50 employees; medium enterprise 50–250 employees; large enterprise > 250

employees.

We calculated mean values and standard deviations across persons for the importance of the

C&O resulting from digitalization. We conducted analyses of variance (ANOVAs) to check whether there

were relevant differences in the importance of individual C&O between the participating companies.

Due to the small sample size, we decided not to carry out a factor analysis for the "Measurement

Instrument for the Assessment of Central Aspects of the NWW" (4). With the given subject-to-item ratio,

the probability of obtaining a correct factor structure would be minimal (37). For this reason, we decided

to conduct the further analyses with the factor structure originally assumed. To obtain scale values, we

calculated the scales of the respective assumed dimensions per person to one value using the scale

means.

We assume that the central aspects of the NWW can influence the perceived importance of the

C&O presented by digitalization and vice versa. Furthermore, it would also be plausible that the different

variables are simultaneously influenced by unknown third variables. For this reason, we do not assume a

causality of influence and choose a correlation matrix to investigate the relationships between the

individual scales and items. As the answer options were ordinal scaled, we have chosen a Spearman rank

correlation as the method of analysis. We are aware that our analyses involve multiple testing. To avoid

alpha error accumulation, we only report results that are at a significance level below 1% (two-sided).

Because of the small sample size, a correction according to Bonferroni or Bonferroni–Holm (38) seems

too strict to us. For all statistical analyses, we used IBM SPSS Statistics 26.

Results

In the following section we describe the results of the online survey and compare these

quantitative results from the end of the WHP projects with the qualitative results of the group interviews

at the beginning of the projects.

Identified Challenges and Opportunities

Table 2 shows the mean importance of challenges rated by the respondents in the online survey.

Table 2

Mean Importance of the Challenges of Digitalization in Companies

Which challenges of digitalization have also arisen in your company, and how important or unimportant are these for your company?	n	M	SD
Managers need to be sensitized to health and digitalization	63	3.2	0.9
Constant availability of employees as a health risk	66	3.2	0.9
Mental strain and stress due to digitalization	65	3.1	0.9
Eye strain due to screen work	65	3.0	1.0
Double tracking occurs digital–analog	62	3.0	0.9

Priority setting must be (re)learned	64	2.9	0.7
Workstation equipment/design must be changed	66	2.9	1.1
Too little awareness of the benefits/harms of social media	59	2.8	0.9
Communication processes are not optimal	63	2.8	1.0
Employees have too few digital skills	64	2.8	0.8
Digitalization makes time management more difficult (e.g., due to many e-mails)	67	2.7	1.0
Too little awareness of dealing with violence/security/data protection on the Internet	62	2.7	1.1
Harmful physical positions due to PC work	62	2.7	1.0
Collaboration made more difficult/impersonal by digitalization	68	2.7	1.0
Information material is out of date	62	2.5	1.0
Employees are skeptical about digitalization	65	2.5	1.0
Employees' overestimation of themselves with regard to digital competences	60	2.4	1.0
Documentation becomes more confusing due to digitalization	65	2.3	1.1
No interest in digital development	62	2.2	0.9
Knowledge transfer is hampered by digitalization	68	2.1	1.0
Employees are skeptical about the WHP project regarding digitalization	65	2.0	1.0
Independence of employees is reduced by digitalization	63	2.0	0.9

Note. 4=very important, 3=rather important, 2=rather unimportant, 1=very unimportant

Respondents rated two challenges as the most important: "Managers need to be sensitized to health and digitalization" and "Constant availability of employees as a health risk" (mean value M=3.2 each). Other important challenges were "Mental strain and stress due to digitalization" (M=3.1) and "Eye strain due to screen work" (M=3.0).

Sensitization to the topic of "health and digitalization" was already addressed at the group interviews, not only explicitly for managers, but for all employees. Constant availability, psychological and physical stress, were mentioned as challenges by several persons in the group interviews.

Two of the most important topics that project leaders discussed in the group interviews were the fears that employees might have skill deficits in dealing with digital media, tools, and equipment and might have reservations about technology. In the online survey, almost 69% of the respondents rated the topic of "Employees have too few digital skills" as very or rather important (M=2.8), while 60% of the respondents rated the skepticism of employees towards digitalization as very or rather important (M=2.5). However, the fear that employees might not be interested in further digital development was rated as rather unimportant in the online survey (M=2.2).

Table 3 shows the mean importance of the different opportunities rated by the respondents in the online survey.

Table 3

Mean Importance of the Opportunities of Digitalization in Companies

Which opportunities through digitalization have also arisen in your company, and how important or unimportant are these for your company?			
	n	**M**	**SD**
Knowledge transfer can be optimized through digitalization	65	3.5	0.6
Communication processes can be optimized through digitalization	66	3.5	0.6
Documentation can be unified/simplified through digitalization	66	3.5	0.7
Digitalization allows work information materials to be designed in a new and clearer way	63	3.5	0.8
Employees' digital skills can be strengthened	64	3.4	0.7
Collaboration becomes more flexible through digitalization	64	3.3	0.8
Employees support WHP project on digitalization	59	3.2	0.7
Analog processes become more efficient through digital support	59	3.2	0.8
Workplaces are made more user friendly (e.g., more efficient equipment)	59	3.2	0.9
Managers recognize the potential of digitalization for health	57	3.2	0.9
Time management can be improved through digitalization	64	3.2	0.8
Employees advocate digitalization	60	3.2	0.6
Creating awareness of the benefits/harms of social media	61	3.1	0.9

Which opportunities through digitalization have also arisen in your company, and how important or unimportant are these for your company?			
Creating awareness for dealing with violence on the Internet	60	3.0	1.0
Work can be made more flexible (e.g., home office)	57	3.0	1.2
Employees work more independently through digitalization	61	3.0	0.9
Digital communication simplifies collaboration (e.g., meetings via Skype possible)	61	2.9	1.1
Priority setting is facilitated by digitalization	61	2.9	1.0
Stress and psychological strain can be reduced through digitalization	61	2.7	1.0
Exercise/healthy nutrition/healthy lifestyle of employees can be promoted through digital offers	58	2.6	1.0

Note. 4=very important, 3=rather important, 2=rather unimportant, 1=very unimportant

The four most important opportunities were the optimization of knowledge transfer, communication processes, documentation, and work information materials (M=3.5 each). Project leaders already frequently mentioned these topics in the group interviews under different keywords, for example, "Optimization of processes," "Security through documentation," "Promoting the exchange of know-how," and so forth.

Another important opportunity was that employees' digital skills could be strengthened (M=3.4). Project leaders discussed this aspect in the group interviews as more of a challenge (see above). Only a few individuals mentioned the strengthening of digital skills as an explicit opportunity to maintain the employees' workability and employability in the coming years.

The flexibility of work was mentioned several times in the group interviews as an opportunity through digitalization. In the online survey, nearly half of the people surveyed (47.4%) rated it as a very important opportunity, but more than one-fifth (21.1%, M=3.0) rated it as very unimportant. The respondents of the online survey also rated "Managers recognize the potential of digitalization for health" as a rather important opportunity (M=3.2).

In the group interviews, it was repeatedly mentioned that digitalization could trigger or increase stress and psychological strain on one hand, but on the other hand, digitalization was also seen as a chance to reduce stress, for example, by making information easier to access. In the online survey, the opportunity to reduce stress and psychological strain through digitalization was rated between rather important and rather unimportant with a mean value of 2.7; in relative terms, this opportunity was seen as one of the least important.

Respondents rated "Exercise/healthy nutrition/healthy lifestyle of employees can be promoted through digital offers" (M=2.6) as the most unimportant opportunity, although this was mentioned frequently in the group interviews.

Only in the rating of two opportunities significant differences ($p < 0.01$) were found between the companies. The mean importance of the optimization of knowledge transfer and the optimization of communication processes differed significantly ($p < 0.01$) across the companies. A complete overview of the mean importance of the C&O of digitalization for each company can be found in in the appendix (Supplementary Tables S2 and S3).

Central Aspects of the New Way of Work and their Relation with Identified C&O

Table 4 shows the mean applicability of the central characteristics of NWW according to the subscales of the "Measurement Instrument for the Assessment of Central Aspects of the NWW" (4) in the surveyed companies and the correlation coefficients between the individual subscales (n = 57–71).

Table 4

Descriptive Statistics and Correlation Coefficients Between the Individual Subscales of the "Measurement Instrument for the Assessment of Central Aspects of the New Way of Work"

Descriptive statistics	Correlation coefficients

	n	M	SD	Cronbach's α	Meaningfulness	Digitalization	Participation	Flexibilization	Boundaryless Work
Meaningfulness	71	4.6	0.5	0.788	1.00				
Digitalization	69	4.4	0.7	0.722	0.176	1.00			
Participation	62	3.5	0.9	0.796	**0.668***	0.109	1.00		
Flexibilization	65	2.9	1.3	0.835	0.200	.224	**0.533***	1.00	
Boundaryless Work	65	2.8	1.1	0.844	0.172	-0.186	**0.454***	0.230	1.00

Note. 1="not applicable at all" to 5="completely applicable." Spearman rank correlation.

* $p < 0.01$

Reliability (Cronbach's α) was acceptable for all subscales (between 0.722 and 0.844). Item-to-total correlations were between 0.288 and 0.827, where the majority of items (20 of 25) varied between 0.5 and 0.8.

Participants in the online survey reported that they rate the meaningfulness of their job as very high (M=4.6). On average, the digitalization of jobs was described as very advanced (M=4.4). The possibility of participation was assessed as moderate (M=3.5). Flexibilization and boundaryless work do not play a very important role on average according to the participants' rating (M=1.3 and 1.1, respectively).

The three subscales "Boundaryless Work," "Participation," and "Meaningfulness" are related relatively strongly and highly significantly (r>0.454, p<0.01).

A Spearman rank correlation shows the relations between the central aspects of the NWW and the rated importance of the identified C&O of digitalization. To avoid alpha error accumulation, we only present results that are at a significance level below 1% (two-tailed).

In none of the challenges of digitalization is the importance significantly ($p<0.01$) related to the central characteristics of NWW. For opportunities, only the subscale "Participation" has a significant correlation ($p<0.01$), with three of the identified opportunities of digitalization: "Employees advocate digitalization" ($r=0.347$; $p=0.009$); "Managers recognize the potential of digitalization for health" ($r=0.366$; $p=0.007$); and "Analog processes become more efficient through digital support" ($r=0.429$; $p=0.001$). A complete overview of the correlation coefficients between the central aspects of the NWW and the C&O are presented in Supplementary Table S4 and S5, both in the appendix.

Discussion

We identified various challenges and opportunities for health and well-being at work that result from NWW. The surveyed WHP project members assessed the importance of the C&O differently and, in some cases, not as expected at the beginning of the WHP project. On average, the opportunities presented by digitalization were considered more important than the challenges that needed to be met.

"Managers need to be sensitized to health and digitalization" was one of the two most important challenges. The need to effectively address this challenge is supported by further studies, which showed that management support is a critical success factor for WHP (39, 40).

The second most important challenge was the "Constant availability of employees as a health risk." To be able to counteract this risk from digitalization demonstrated by numerous studies (41-43), it is not only necessary for employees to handle digital media responsibly, but also for companies to implement a corporate culture of responsible media use (42).

Further important challenges are mental and physical strains. Although digitalization is often referred to as more stress related and mentally demanding (18), research suggests that digitalization can also lead to a reduction in mental demands and workload through flexibilization and optimized communication (44).

We found some disadvantages of the NWW described in the literature at least partly confirmed in our research. Increasing conflicts as well as decreasing social support and communication (16) become

apparent in the challenge that digitalization would make collaboration more difficult or impersonal, which was at least rather important for more than half of our respondents. Contrary to this, studies showed that digitalization can even help connectivity among staff (18). In addition, the optimization of communication processes was one of the four most important opportunities of digitalization, together with the optimization of knowledge transfer, documentation, and work information materials. Interestingly, there were significant differences between the companies in the assessment of importance for two of these opportunities: optimization of knowledge transfer and optimization of communication processes. Regardless of whether these topics are seen as a challenge or an opportunity, the potential of digitalization should not be ignored in this context, as communication is one of the most important success factors for companies (45-48).

Although the promotion of a healthy lifestyle for employees through digital tools was mentioned frequently as an opportunity of digitalization in the group interviews, this aspect was rated as rather unimportant in the online survey. It is possible that the expectations of eHealth tools are higher than the actual achieved benefits. These results are in line with further research: although a number of eHealth tools exist for integration in the WHP process (49), digital interventions only seem to have a limited impact on health outcomes at work (50).

Digitalization as a central aspect of the NWW is quite established in the surveyed companies, while flexibilization and boundaryless work are not rated so highly. In general, we found no relevant statistical relationship between the central aspects of the NWW and the perceived challenges resulting from digitalization, but these results must be interpreted with caution due to the small sample size. With regard to the perceived opportunities offered by digitalization, we found relevant positive correlations for "participation" with employee support for digitalization, with the recognition of the potential of digitalization for health by managers, and with greater confidence that analog processes would become more efficient with digital support. It is possible that the higher level of employee participation will mean that some of the opportunities of digitalization can be better and more easily exploited. The importance

of participation is highlighted as one of the four basic principles in the Luxembourg Declaration on WHP

in the European Union, which are recognized as quality guidelines for WHP (31).

We believe that the multistage, mixed-methods approach and the involvement of different

companies was a suitable method for investigating our research questions. Nevertheless, we are aware

that our study has certain limitations. Probably the most important limitation is the small sample size.

However, since it was important to us to collect data only from companies that had relatively

simultaneously implemented a WHP project, we were unable to reach a larger sample.

We developed the survey tool we used to address the C&O of digitalization for health and well-

being at work that could be used by others for further research using a variety of data sources and

applying different research methods.

Conclusions

We examined some rather interesting differences in the perceived C&O between the group

interviews at the beginning of the WHP projects and the results of the online survey towards the end of

the projects. We assume that the statements made in the group interviews were assumptions of the

project leaders, which were either then confirmed or not confirmed in the course of the project. This

demonstrates the need for a survey of the C&O presented by NWW before implementing measures.

Acting based on assumptions, even if they are made by experts, could waste a lot of resources.

Another interesting result was that towards the end of the projects, the perceived opportunities

were, on average, rated as more important than the perceived challenges. The intensive work on the

topic may have led to a shift in the perspective of the "threat" posed by digitalization towards an

opportunity-oriented perspective. Combining the two issues "digitalization" and "health and well-being

at work" can therefore lead to a win-win situation: promote the advancement of digitalization in the

company while at the same time promoting the health of the employees.

Companies should therefore take advantage of the benefits of addressing the topics of NWW

and health and well-being at work together. WHP has a huge potential to help companies dealing with

the C&O of digitalization. Furthermore, companies should especially address target groups from lower

socioeconomic positions (30) to reduce the risk of growing social inequalities and health risks through

NWW (15, 20).

To realize meaningful and target-oriented solutions, companies should identify the C&O

perceived as most important before starting to implement measures. If these principles are accounted

for, WHP can definitely support the digital transformation change that companies face today.

List of abbreviations

ANOVAs, analyses of variance

C&O, challenges and opportunities

HP, health promotion

M, mean value

NWW, new ways of work

WHP, workplace health promotion

Declarations

Ethics approval and consent to participate

We did not submit our research proposal to an ethics committee. According to the Austrian

University Law, ethics committees are obligatory for the "assessment of clinical trials of drugs and

medical devices, the application of new medical methods and applied medical research on humans"

(https://www.ris.bka.gv.at/Dokumente/Bundesnormen/NOR40168177/NOR40168177.html, in German),

which is not applicable for our study. Furthermore, we did not collect personal/sensitive data. Informed

consent was provided by all participants. For the focus groups, the respective project leaders were

informed in advance, both by telephone and in writing, about the purpose of the research project and its

procedure, and had the opportunity to ask questions. Before the start of the focus group, it was explicitly

explained how the collected data would be handled and verbal consent was obtained for the further use

of the data from the persons present. In the written survey, the first page of the online questionnaire

provided complete information about the purpose of the research, pointed out the voluntary nature of

participation, and explained the further use and storage of the data. If the subjects continued to answer the questionnaire afterwards, we assumed their consent. We followed the existing principles for research ethics (51), ensured confidentiality and privacy and raised participants' permission to use the information they give us for research purposes. This permission was even granted for photographic material from all participants.

A prerequisite for the funding of the occupational health projects was the willingness of the twenty companies to participate in the external evaluation. However, if participation in the surveys was not possible, for example, because of time constraints, this did not have any negative consequences for the companies. Company representatives were allowed to submit travel expenses for participation in the group interviews as part of the grant. We provided catering for the participants during the group interviews. Beyond that, there were no other further incentives or compensation for participation in the surveys.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request and with permission of the funding institution (Austrian Health Promotion Fund, Austrian National Public Health Institute, Vienna, Austria)

Competing interests

The authors declare that they have no competing interests

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Author's contributions

BT, GL, LA, and LG conceived and planned the described research project. BT and LA carried out the data collections and analyses. GL and LG helped supervise the project. BT took the lead in writing the manuscript. All authors discussed the results and contributed to the final manuscript.

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Author's information

BT is currently working at the IMC University of Applied Sciences Krems, Department of Business.

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