

Altepost, Andrea; Elaroussi, Farah; Hansen-Ampah, Adjan; Harlacher, Markus;  
Merx, Wolfgang

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# Assessing organizational framework conditions for the successful, human-centered introduction of AI applications

Andrea Altepost<sup>1</sup> · Farah Elaroussi<sup>1</sup> · Adjan Hansen-Ampah<sup>1</sup> · Markus Harlacher<sup>2</sup> · Wolfgang Merx<sup>1</sup>

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## Abstract

As part of WIRKsam Competence Center, the authors aim to identify and improve organizational conditions in companies that are conducive to the successful introduction of AI technologies in the workplace. This paper examines various factors that are considered crucial for effective AI integration, including technology acceptance, access to IT infrastructure, workforce structure, organizational culture and participatory practices. Using a mixed-methods approach, WIRKsam relates the initial organizational conditions to the researchers' assessments and experiences of the first 24 months of the study. The analysis uses both qualitative and quantitative data and provides a robust framework for identifying the respective organizational prerequisites.

It aims to map these factors and provide insights. Our results show the application partners involved in WIRKsam as companies with individual characteristics of technology and AI affinity as well as different organizational cultures. The workforce is predominantly male. Slightly more than half of the employees are 45 years and older. Overall, the research activities in WIRKsam are met with openness to electronic devices and AI. However, the fears of the employees are somewhat underestimated by the researchers. Employees rate their knowledge and experience with regard to AI as low and need support here in order to be able to participate in the participatory design of work systems in a more informed way. Management support is a key aspect of technology adoption that employees find important. Their absence is accompanied by worries about the job and lower expectations of positive changes in work, among other things. The knowledge gained will be incorporated into the development of tailor-made action plans to optimize conditions in similar environments.

*Practical relevance:* Using the example of the application companies in WIRKsam Competence Center, the results show that there are very different combinations of framework conditions for the successful introduction of AI into operational practice in companies. Action plans can be derived to individually adapt the integrated approach according to the WIRKsam procedure model. The applied mix of methods allows a very comprehensive analysis and contributes to the validity of the results. In particular, the survey of researchers contributes to new findings, the importance of which lies on the one hand in complementing the perspective of employees and the company as a whole, and on the other hand in providing the researchers themselves with a basis for reflecting on their basic assumptions as an entire research team.

**Keywords** Work design · Artificial intelligence · Organizational framework conditions · Human-centered technology introduction

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✉ Dr. phil. Andrea Altepost  
andrea.altepost@rwth-aachen.de  
  
Wolfgang Merx, M.A.  
a.altepost@ita.rwth-aachen.de

<sup>1</sup> Institut für Textiltechnik der RWTH Aachen University,  
Templergraben 55, 52062 Aachen, Germany

<sup>2</sup> ifaa—Institut für angewandte Arbeitswissenschaft e. V.,  
Uerdinger Str. 56, 40474 Düsseldorf, Germany

# Bewertung der organisatorischen Rahmenbedingungen für die erfolgreiche, menschenzentrierte Einführung von KI-Anwendungen

## Zusammenfassung

Im Rahmen des Kompetenzzentrums WIRKsam wollen die Autorinnen und Autoren organisatorische Bedingungen in Unternehmen, die für die erfolgreiche Einführung von KI-Technologien am Arbeitsplatz förderlich sind, identifizieren und verbessern. Dieser Beitrag untersucht verschiedene Faktoren, die für eine effektive KI-Integration als entscheidend erachtet werden, darunter Technologieakzeptanz, Zugang zur IT-Infrastruktur, Belegschaftsstruktur, Unternehmenskultur und partizipative Praktiken. Mit einem Mixed-Methods-Ansatz setzt WIRKsam die organisatorischen Ausgangsbedingungen mit den Einschätzungen und Erfahrungen der ersten 24 Monate der Untersuchung aus Sicht der Forschenden in Beziehung. Die Analyse nutzt sowohl qualitative als auch quantitative Daten und bietet einen robusten Rahmen zur Identifizierung der jeweiligen organisationalen Voraussetzungen. Sie zielt darauf ab, diese Faktoren abzubilden und Erkenntnisse zu liefern. Unsere Ergebnisse zeigen die in WIRKsam involvierten Anwendungspartner als Unternehmen mit individuellen Ausprägungen von Technologie- und KI-Affinität sowie unterschiedlichen Organisationskulturen. Die Belegschaften sind überwiegend männlich geprägt. Etwas mehr als die Hälfte der Mitarbeitenden sind 45 Jahre und älter. Insgesamt wird den Forschungsaktivitäten in WIRKsam mit Offenheit für elektronische Geräte sowie KI begegnet. Die Ängste der Mitarbeiter werden von den Forschern jedoch etwas unterschätzt. Mitarbeitende schätzen ihr Wissen und ihre Erfahrung in Bezug auf KI als gering ein und benötigen hier Unterstützung, um sich an der partizipativen Gestaltung von Arbeitssystemen informierter beteiligen zu können. Die Unterstützung durch das Management ist ein zentraler Aspekt der Technologieeinführung, den die Mitarbeiter als wichtig empfinden. Ihre Abwesenheit geht unter anderem mit Sorgen um den Arbeitsplatz und geringeren Erwartungen an positive Veränderungen in der Arbeit einher. Die gewonnenen Erkenntnisse fließen in die Entwicklung passgenauer Maßnahmenpläne zur Optimierung der Bedingungen in ähnlichen Umgebungen ein.

*Praktische Relevanz:* Die Ergebnisse zeigen am Beispiel der Anwendungsunternehmen im Kompetenzzentrum WIRKsam, dass es sehr unterschiedliche Kombinationen von Rahmenbedingungen für eine erfolgreiche Einführung von KI in die betriebliche Praxis in Unternehmen gibt. Anhand dessen können Maßnahmenpläne abgeleitet werden, um die integrierte Vorgehensweise gemäß WIRKsam-Vorgehensmodell individuell zu adaptieren. Der angewandte Methoden-Mix erlaubt eine sehr umfassende Analyse und trägt zur Validität der Ergebnisse bei. Insbesondere die Befragung der Forschenden trägt zu neuen Erkenntnissen bei, deren Bedeutung einerseits darin liegt, die Sichtweise von Mitarbeitenden und Gesamtunternehmen zu ergänzen, andererseits darin, den Forschenden selbst eine Basis zur Reflexion ihrer Grundannahmen als gesamtes Forschungsteam zu bieten.

**Schlüsselwörter** Arbeitsgestaltung · Künstliche Intelligenz · Organisationale Rahmenbedingungen · Menschenzentrierte Technikeinführung

## 1 Introduction

Admittedly, it is not a new insight that the introduction of a new technology in work systems does not only require technical prerequisites to be examined or created. A socio-technical approach has long been recommended (e.g. Strohm and Ulich 1997; Ulich 2013). Nevertheless, the practice often still looks quite different (Parker and Grote 2022). Additionally, experience with the introduction of artificial intelligence (AI) into the world of work is also still “work in progress”. The present article therefore makes suggestions for suitable instruments for the analysis of the current situation, presents the results of an analysis achieved with them in the Competence Center of Labor Research WIRKsam and shows by way of example how practical measures for participatory AI development and introduction can be derived from them.

When it comes to developing AI and introducing it into corporate practices, data is usually cited as one of the most important prerequisites (Ransbotham et al. 2017; Reim et al. 2020). This is undisputed for the technical development and the identification of correlations for the purpose of predictive capability of the AI application. However, other influencing factors are relevant for the introduction of AI applications in operational practice: age structure of the workforce (Ferdous 2023), access of employees to IT infrastructure (Schindler and Schmehing 2021), acceptance of technology (Akyazi 2023), corporate culture (Lee et al. 2023), and lived participation (Haipeter et al. 2024) are only some of the factors to be considered here. The goal of this paper is to assess the organizational framework conditions necessary for the successful human-centered introduction of artificial intelligence applications in workplaces for eight application partners of WIRKsam Competence Center, which are companies from textile and related industries.

Here, we find a large variety of use cases with high potential for improving work conditions as well as operational and economic issues by methods of artificial intelligence (AI). In nine use cases, the WIRKsam research team is working with application companies and AI enablers to develop AI-supported work systems, each of which addresses specific operational problems.

The wide range of prerequisites and their combinations found for the introduction of AI in the WIRKsam companies can serve as a fund for the formation of hypotheses with a view to a possible generalization of the results. In this sense, the paper can also be understood as a case analysis in the sense of, for example, (Schnell et al. 2011, p. 243), which does not serve to test the theory, but to generate hypotheses. The diversity of aspects considered and data collection methods used, also from the qualitative spectrum, mentioned by (Schnell et al. 2011), is also given in the present paper by the mixed-methods approach and can provide impetus for a variety of further investigations.

An unusual element of the study is the additional perception of the corporate situation by the participating researchers. This not only contributes to the reflection of their basic assumptions and paves the way for a more flexible approach that is oriented towards individual framework conditions in the project. Larger deviations between the perceptions of employees and researchers can also provide an opportunity to investigate the reasons for these differences, e.g. in the assessment of knowledge about AI.

As part of the work in WIRKsam Competence Center, a procedure model and various empirical instruments were developed with which, among other things, the framework conditions for the introduction of technology can be empirically recorded (Harlacher et al. n.d.). The WIRKsam procedure model is composed of a work science cycle and a technical cycle dedicated to AI development. An ergonomic phase model (Schmid et al. 2020), a model of participatory system development (Altepost et al. 2021) and the data-based CRISP-DM model (Wirth and Hipp 2000) interlock at certain points to form a holistic approach. In the orientation phase, ergonomics and computer science make use of both common and specific instruments and come together again in the focusing phase for an integrated assessment of the need for change and the associated requirements for the transformation of the socio-technical system. It is this phase where the data collection presented here is located. Based on a joint socio-technical specification sheet, tasks arise that are carried out in the realization phase, partly in parallel (e.g. AI programming vs. preparation of working system test using initial prototypes of user interfaces) and partly together (e.g. testing and derivation of implications for further iteration loops). With a view to the stabilization phase, the implications for work design, qualification and organizational measures identified in the socio-techni-

cal specifications are also transferred into recommendations for action for the subsequent operational implementation of the AI-supported work system. The integrating basis of the process model is the HTO approach (Strohm and Ulich 1997; Ulich 2013). It considers human, technical and organizational aspects of a work system holistically and with their interactions, which are considered at relevant points as outlined.

Summing up, the article presents empirical results based on an explorative study gained from the application of survey and interview instruments in companies representing eight use cases of WIRKsam. Both qualitative and quantitative data were collected. We additionally compare the results with the researchers' assessments of the preconditions for the WIRKsam project activities. Overall, this provides a deeper insight into a part of the focusing phase of the process model, which deals with identifying fields of action and initiating concrete measures. Based on the empirical data, we aim at deriving framework conditions that are conducive to the successful, human-centered, participative introduction of AI applications. It is important for us to gain insights into the different "profiles", i.e. situational combinations of prerequisites, of companies and to coordinate the application of further phases of the process model to them. The mixed-methods approach used enables a comprehensive analysis, which also includes the basic assumptions of the research team.

## 2 Methodology

This article deals with an explorative empirical study, the aim of which is to obtain information about the characteristics of the work systems (understood as socio-technical systems) in the companies applying the WIRKsam project. This information is required to design individually tailored change processes for the introduction of AI. At the time of the analysis, there were no quantitative hypotheses about the correlations between, for example, workforce structure and the desired design features of the work system. These can be developed from the results in a second step if necessary. By combining different empirical methods, the approach can address the company's structure, culture etc. from multiple angles, leading to a comprehensive picture. Each method contributes unique insights that are critical for understanding and improving the socio-technical system in which AI operates. This ensures that the AI technologies developed are relevant and applicable to the specific contexts of the participating companies. Our methodology allows for continuous learning and adaptation throughout the project. By assessing both the starting conditions and ongoing experiences during the project, it is possible to make iterative improvements that are informed by real-world feedback and

data. Further, by regarding the individual preconditions of each company, we aim to ensure that the development and implementation of AI systems consider the well-being, capabilities, and needs of the workforce. This not only helps in technology acceptance but also in aligning the technology with the users' and organization's goals.

## 2.1 Overarching methodology

We apply a mixed-method approach which consists of company surveys, workforce structure analysis and observation interviews, recording the actual situation in the pilot area as well as the organizational framework conditions for it. By focusing company entities beyond the direct project area up to the whole company site, the framework conditions of the employees' operational socialization are examined, but also upstream and downstream areas connected in the process flow (Fig. 1).

In detail, the instruments presented here include an employee survey (company survey or employees survey), which takes the perspective of the individual employees; furthermore, a workforce structure analysis that takes into account socio-economic characteristics of the workforce for the entire company or location, interviews in the context of activity observations and the perception of the corporate environment by the participating researchers. The company survey aims at capturing corporate culture, affinity for technology and participation (Harlacher et al. [n.d.](#)), and addresses a comprehensive range of topics that are relevant in connection with the introduction of AI technologies.

The purpose of the workforce structure analysis was to obtain an inventory of key structural characteristics of the workforces of the nine application companies, most of which belong to the textile industry. In terms of participants,

the workforce structure analysis covers all employees of the company respective the local plant. With these data, we aimed to ensure both the technical and social connectivity of the design process and to involve the stakeholders in the company in a target group-oriented manner (see Harlacher et al. [n.d.](#); Strohm and Ulich [1997](#); Ulich [2013](#)).

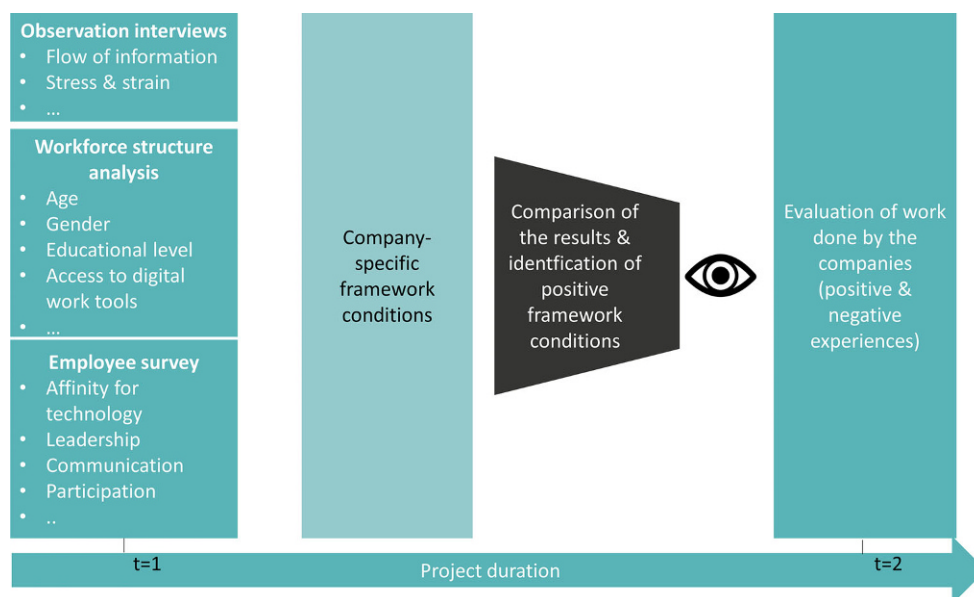
The observation interviews aimed at job activity related topics. The work task is at the heart of the HTO approach, so that the interviews show, among other things, how employees are integrated into knowledge and process structures in the company as part of their work.

Finally, we contrast the results of the employee survey and interviews with the assessment of the research partners on the relevant topics to round off and, where possible, validate the results by combination of internal and external perspectives. The research partners of the WIRKSam project evaluated the conditions in the companies flanking the project and the quality of collaboration in the respective use cases.

As Harlacher et al. ([2024](#)) note, a company-specific approach is needed to characterize the individual companies, i.e. use cases, with the data obtained. For data protection reasons, this is not fully possible in the context of a publication. For this reason, in the results section we will present average values for each item resp. index only across all companies combined with a ranking of companies for each item/index. It is important not to see this ranking as a "performance order", but as a value-neutral classification of the respective mean values to work out profiles of the companies and to be able to derive examples for recommendations in preparing project measures. For example, company A is not "weaker" than company B if, for example, its employees have more fears about artificial intelligence than those of company B. Rather, A can use this knowledge to check

**Fig. 1** Mixed methods approach to analyzing conducive framework conditions for the introduction of AI

**Abb. 1** Mixed-Methods-Ansatz zur Analyse förderlicher Rahmenbedingungen für die Einführung von KI





whether the employees' fears make it advisable to provide a more realistic picture of AI in training offers, for example, to prevent stress or acceptance problems. Moreover, the explicit values behind the rankings are often close together and a rank "8" does not have to mean that a company has a bad result in the respective question.

## 2.2 Company survey on corporate culture, affinity for technology and participation

Starting with technology-related questions about the acceptance of electronics following TA-EG inventory (Karrer et al. 2009) and items concerning perception and knowledge of AI, the survey proceeds to topics of corporate culture. Items on experience in dealing with AI-supported systems have already been used in a questionnaire of the KOMPAKI competence center. For the assessment of organizational culture, the associated items were derived based on the preliminary work by (Martins and Terblanche 2003), (Jöns et al. 2005) and (Conrad et al. 2019). For the present article, the questionnaire was transformed into a structure that later makes it possible to relate those items to the results of the researcher survey. Not all individual items seemed suitable for this purpose. To parallelize the researcher survey, the items were first subjected to an exploratory factor analysis in thematic blocks. There were five factors for the TA-EG, two for the AI items and two for the items on corporate culture. Within these factors, questions were summarized to such an extent that they appeared to be answerable by the researchers in terms of content. A summary mean index was compiled for the TA-EG, which is reflected in the researcher survey as a question of how employees' attitudes towards electronic devices are assessed overall. Within the factors obtained in each case, items were partly summarized, on the one hand to keep the effort of the response within reasonable limits—the researchers sometimes had to work on the survey for four to five companies—and on the other hand so as not to make the answer more difficult due to too specific or too broad a focus on content. For example, the items "Electronic devices have negative effects on health" and "Electronic devices cause stress" were summarized as "Employees are concerned about health aspects of electronic devices". On the other hand, e.g. the item "Electronic devices lead to mental impoverishment" was not considered separately because it seemed too specific to be answered by the researchers.

Furthermore, the instrument PASST (Altepost et al. 2024), designed as a participative concept to implement a digital assistance system in the textile industry, is part of the above-mentioned survey. In WIRKsam, we use PASST, including 35 measures identified in a literature review, to gather insights on participative measures preferred by employees when introducing new digital technologies in

the workplace. To increase the acceptance of the survey in the companies, anonymization was guaranteed and the collection of socio-economic data such as age, gender or level of education was dispensed with. To do this, we are therefore dependent on the results of the workforce structure analysis. To infer from the age structure of a complete workforce, for example, that of a much smaller project area, carries the risk of an ecological fallacy. However, it may be possible to obtain indications for hypotheses that can be useful for detecting correlations between certain factors in the company and, if necessary, can be used to determine the relationship between certain factors. can also be taken up in further scientific studies.

The questionnaire could be completed both on paper and in an online version. Based on feedback from the participating application companies, explanations were also added in easy-to-understand language to make it easier to complete the questionnaire, particularly in the manufacturing sectors. The company survey was completed by 182 employees from eight (of nine) application companies of WIRKsam Competence Center. The data were analyzed by use of SPSS statistics software.

To ensure the anonymity of the company data, no sub-sample sizes or other company characteristics will be reported in the results section. However, it has already been pointed out that the number of respondents varies greatly between companies, the frequencies are not normally distributed, and approximately equal variances cannot be assumed either. In the case of comparisons, this can lead to methodological problems. The reported results are therefore descriptive in nature.

## 2.3 Workforce structure analysis

The comprehensive tabular personnel statistics concept of one of the competence center's application companies was used as a template. Almost all relevant data was available here in a tried-and-tested form and only had to be supplemented by the researchers in the area of IT involvement. The items selected for the form initially comprised socio-demographic information, namely gender and age distribution, nationality and the education and qualification level of employees in the period from 2016 to 2022, in each case in total and broken down into industrial and commercial areas. In addition, the staffing plan (target/actual, industrial and commercial) and the fluctuation rate since 2016, the organizational areas with the number of employees, the type of shift operation, the types of employment contract, the sickness rate since 2016 and the training and further education rates since 2016 were also surveyed. To gain an insight into the company's IT infrastructure, the survey also asked how many employees had computer access, their own company computer and/or their own company email address.

After sending the form by e-mail to the nine application companies, the results of seven companies were included in the analysis. One was excluded due to the small number of employees and there was no response from another. The data requested was submitted by the companies in varying degrees of completeness. One company only returned part of the requested data in its own form and without reference to the form sent out. Data for workforce structure analysis were provided by seven companies, relating to 1339 employees.

## 2.4 Observation interviews

The companies are hereinafter referred to as U1 for company no. 1, U2 for company no. 2 etc. Seven observation interviews were conducted in the context of a work analysis: one each in U4, U5 and U7, two each in U3 and U8. In U1, U2 and U6 no observation interviews were possible. Employees affected by the intended changes in the work system were observed doing their job in the current manner. In addition to documenting what was observed, the researchers posed questions concerning several aspects of the work task. For this purpose, a partially standardized guideline was developed. First, it referred to the knowledge management and qualifications needed for the machine operators. It further explored what kind of knowledge is crucial or required for the role and what someone representing this position should know and be capable of doing. In addition to that, the interview investigated the importance of experiential knowledge in the overall process and to what extent this knowledge is shared with other team members. The guideline also contained questions to examine the current methods of securing and processing existing knowledge. Furthermore, the interview looked at existing measures to promote the skills and qualification development of the individual that operates the machine, including qualification, questions of strain and relief measures. Second, there were questions to assess time aspects of the work task including the time required for machine setup and the strain on employees due to planning errors. Third, we explored topics of attractiveness of the current job position. To this end, the workers were asked to evaluate assigned activities on a scale and to provide insights into why they find them attractive or unattractive.

## 2.5 Research partners survey

To compare the results with the outcomes of the company survey described in Sect. 2.2, parallel questions were developed as far as possible, which allowed the researchers to assess or evaluate an issue—e.g. the AI competence of employees. The procedure for constructing the questionnaire has already been described in more detail in Sect. 2.2. The

researcher survey was made available by means of an online questionnaire. For each use case (company), one questionnaire had to be filled out by each researcher who was involved. The respondents were asked to name their discipline (work science or computer science). Further information on the respondents was not collected due to the small sample size (less than 25 persons from three research institutes involved in WIRKsam) to maintain anonymity. At the beginning of the questionnaire, respondents were given information on the purpose of the survey as well as explanations on how to complete it. Since some of the topics, such as possible health effects of electronic devices, may or may not have been a topic of discussion in all project teams and company visits, the respondents were explicitly asked to refrain from assessing an item if they were unsure. Further, the researcher survey included questions about the participation of employees in the project to assess the quality of the cooperation and the competence or willingness of employees to take part in the project activities.

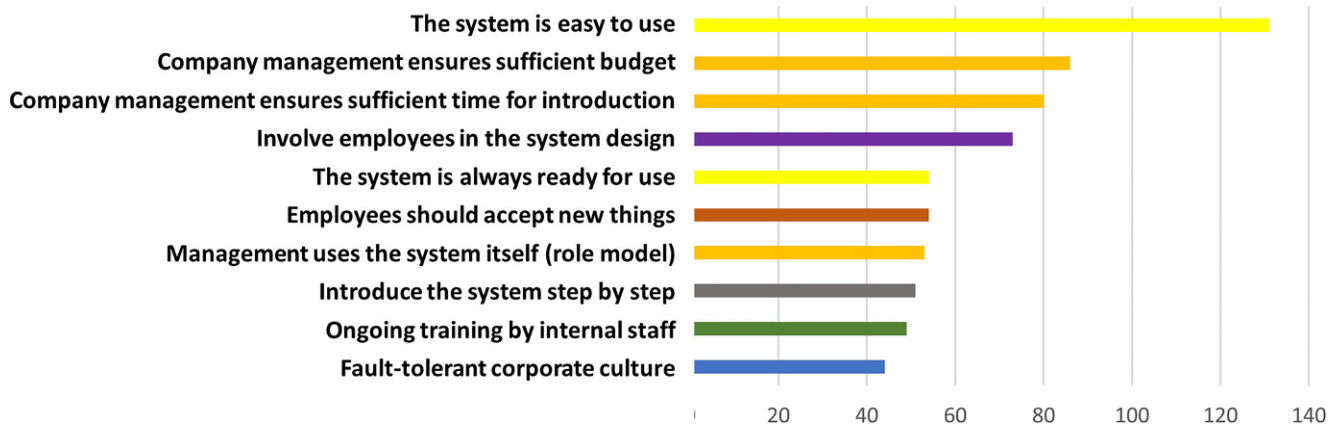
In addition to individual topics that the researchers were not able to observe in their contacts with companies, the respective affinity group also posed a challenge. The company survey was rolled out beyond the direct project area—partly to the entire site (small companies) and partly to the department in which the project area is embedded. The workforce structure analysis, on the other hand, covers the entire company site. The researchers were therefore asked to submit their assessments separately for the employees of the direct project area and for the employees of the site. Since their conversations and experiences in the company beyond the direct project area were rather selective and random, and it seemed hardly feasible to assign them to the demarcated survey area. It must therefore be assumed that the results are not based on exactly the same groups of people. However, it can be assumed that the corporate culture is represented in the smaller units to a certain extent.

Moreover, the group of employees in the direct project area is of different compositions depending on the application. Most of them are workers on the shop floor, but sometimes managers are also involved. Separate assessments were collected for other managers who are involved in the project but do not themselves belong to the direct project area, but these are not discussed further here.

The mentioned challenges resulted in higher numbers of missing values for items concerning the entire site.

## 3 Results

In the following chapter, we go into detail about the results of each instrument.



**Fig. 2** Measures from PASST with the 10 highest point totals

**Abb. 2** Maßnahmen aus PASST mit den 10 höchsten Punktskizzen

### 3.1 Company survey

In this section, we limit ourselves to presenting the results of the sub-questionnaire PASST. The results of the other sub-questionnaires are reported in Sect. 3.5 directly in comparison with the researcher survey.

The questionnaire part PASST was completed by a total of  $N=114$  people. Since not every item was answered, but only 1–10 points were awarded for preferred measures, company-specific results can hardly be meaningfully interpreted in comparison. The ten most frequently selected measures are shown in Fig. 2.

The company's management is seen as having a duty here with three measures in the "top ten". In addition to a sufficient budget, time is expected for the introduction of technology and a role model function for the company's management. In addition, the respondents would like to see a fault-tolerant corporate culture. Employees—i.e. ultimately the respondents themselves—should be involved in the system design but should also be prepared to accept new ideas. It is also important to those surveyed that the system is ready to function reliably and that it is easy to use.

### 3.2 Workforce structure analysis

Due to the inconsistent data situation of the workforce structure analysis, mainly isolated cross-company statements can be made. A total of 1339 people are employed in seven companies, of which 1033 are men and 306 women. Despite the differences in size, it is noticeable that far more men than women work in all companies, particularly on the shopfloor. Six companies commented on the age structure of their workforces, which is similar across the board. The focus here is on 45- to 59-year-olds, who make up 48% of all employees. In contrast, employees aged 18 to

24, together with minors, make up only around 8% of the workforce. All other age groups (25 to 34, 35 to 44 and 60 years and older) are almost equally distributed at 13 to 16%. Regarding the school-leaving qualifications of all employees, on which four companies commented, there is an almost equal, one-third distribution between lower secondary school-leaving qualifications, intermediate school-leaving qualifications and the Abitur or general/specialized higher education entrance qualification. Four companies provided information on their IT infrastructure. Around 94% of all employees at these companies have access to a company computer. Around 48% of all employees have their own company computer, although the distribution is almost equal among the companies. Around 50% of all employees in five companies commenting on this topic have their own email address. Few statements can be made comparatively regarding companies. In U1, U3 and U7, for example, the proportion of people aged 45 and over is over 60%. U2 and U5 report around 40% of their workforce in this age group. Not all people with computer access have their own e-mail address in the sense that digital communication is part of their everyday work in an institutionalized way (it is not known to what extent employees communicate with each other informally via Whatsapp or other messengers). U5 provides 40% of its employees with an e-mail address, U3 46%, U7 61% and U1 70%. No differentiation was made according to company divisions in this question. The assumption that individual e-mail addresses are more common in the administrative area of the companies than on the shop floor would have to be checked in detail.

### 3.3 Observation interviews

Observational interviews have been evaluated for five companies so far. All interviewees refer to a high level of exper-



tise required, in some cases up to decisive intuition (U8), which is mainly acquired through experience. Experiential knowledge is therefore essential. For U7, it sounds like it should be better appreciated. A high level of responsibility is emphasized above all for U3. Suggestions from employees are not always implemented: in U3 they are sometimes not feasible for technical reasons, although they are welcome. In U7, from the point of view of the interviewee, there is also the avoidance of suggestions; there is a need for improvement in communication between management and operational levels, as well as an explicit desire to be more involved in decision-making processes, especially when introducing new technologies. Physical and/or mental strains in the work are highlighted by the interviewees in U3 and U4. Employees from U3 (limited support), U7 (lack of support) and U8 commented on company support; there, they react quickly to stresses or problems and adapt work equipment or processes if necessary. Further indications of different cultures in companies concern learning culture and knowledge exchange. Systematic training with the aim of keeping employees up to date with the latest technical and qualification standards is reported from U4 and U5. In both companies, there is also an informal exchange of knowledge within the team; the interviewee from U4 explicitly mentions joint work and ongoing feedback, and direct observation and participation in the activities of experienced employees also plays a major role in U5. In U7 and U8, learning takes place mainly informally, and the interviewee from U7 explicitly addresses time pressure due to production requirements in this context.

### 3.4 Synopsis company survey—researcher survey

The results of the researcher survey are compared to the company survey below. The researchers completed 25 questionnaires—one for each company with which they have project-related contact.

As mentioned in Sect. 2.4, higher numbers of missings occurred in items concerning the entire site. For this reason, we primarily report results for the direct project area and give only selected results for the site. To this end, we present the results of the Researchers survey in a synopsis with those of the company survey, keeping in mind that the two surveys refer to different samples.

182 people from eight WIRKsam companies took part in the company survey. With two exceptions, a Likert scale with four characteristics of 1—Not applicable; 2—Rather not true; 3—Rather true to 4—Fully applicable—was used. We present average values for each item resp. index only across all companies. These average values were computed from average means of each company, i.e. weighted in the sense that the different sample sizes of the companies are balanced. Additionally, we provide a ranking of companies for each item/index. The company with the highest value (for positively polarized items, otherwise with the lowest value) gets rank 1, the one with the next highest (resp. lowest for negatively polarized items) has rank 2, and so on.

The parallelization of the survey instrument for the researcher survey makes it easier to summarize the results of the employee survey on the one hand and the researcher sur-

Item \ Company Nr.	1		2		3		4		5		6		7		8		Arithm. Mean		Total N	
Empl.=Employees,eD=Electronic devices *except Average attitude towards eD /h: high value=high rank; /l: low value=high rank	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS	RD 5->1*	CS 1->4	RD	CS
RS: Average attitude towards eD/h CS: Total mean index TA-EG/h	1	8	4	3	2	6	3	1	6	2	6	4	4	5	8	7	4,37	2,93	24	182
RS: Negative effects of eD on health/h CS: Mean index neg. health effects/l	1	8	3	5	6	7	4	1	1	2	5	3	8	6	6	4	4,50	2,31	24	179
RS: Neg.effects of eD on soc. contact/h CS: Mean index neg.for social contact/l	6	7	2	6	1	8	3	2	6	1	4	5	6	4	5	3	4,41	2,88	20	172
RS: Empl. interested in new eD?/l CS: Mean index interest in new eD/h	1	7	3	3	5	4	2	1	5	2	5	5	3	8	5	6	1,65	2,61	25	180
RS: Self-efficacy digitalization and AI/l CS: Mean index self-efficacy eD/h	1	8	3	1	5	6	2	5	6	3	6	4	3	7	6	2	1,63	3,15	24	180
RS: eD increase status in Work/l CS: Mean index eD incr.status i. work/h	3	7	1	2	5	4	2	1	6	4	4	6	8	3	7	8	3,15	2,90	19	182
RS: Work-related benefits in eD/l CS: Mean index Utility of eD/h	3	7	2	2	3	5	1	3	8	5	6	1	3	4	6	8	1,66	3,56	25	182

**Fig. 3** Synopsis researcher survey/direct project area—company survey: Electronic Devices; RD researcher survey-direct project area; CS company survey

**Abb. 3** Synopse Forschendenbefragung (direkter Projektbereich)/Unternehmensbefragung: Elektronische Geräte; RD Forschendenbefragung (direkter Projektbereich); CS Unternehmensbefragung

Item	Company Nr.																Arithm. Mean		Total N	
	1	2	3	4	5	6	7	8												
<i>Empl.=Employees</i> <i>*exc. Know...about AI and Already used AI</i> <i>/h: high value=high rank;</i> <i>/l: low value=high rank</i>	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS
RS: The empl. know a lot about AI/I CS: I know a lot about AI (1=no,2=yes)/h	1	7	2	1	6	5	6	2	4	4	8	3	4	8	3	5	3,16	1,23	21	174
RS: The empl. have already used AI /I CS: I have already used AI (1=no,2=yes)/h	1	4	3	2	5	6	4	8	--	3	1	5	6	6	7	1	1,90	1,42	13	180
RS: AI scares the employees/h CS: AI scares me/I	1	7	4	8	4	3	3	2	8	1	1	6	7	5	4	4	4,70	2,01	22	163
RS: Positive change in work through AI/I CS: MeanInd. Pos. change in work th. AI/h	3	6	3	3	6	5	2	1	7	2	8	7	3	8	1	4	1,78	3,12	24	169
RS: Empl. fear of being replaced by AI/h CS: AI will replace human work/I	1	3	4	5	5	8	3	1	8	2	6	4	1	6	7	7	4,63	2,34	23	162
RS: Empl.: AI will change work a lot/I CS: AI will revolutionize my work/h	2	2	4	3	2	6	1	1	8	3	4	5	7	7	4	8	3,44	2,92	21	144
Rank averages (rounded to whole numbers)	1	5	4	4	5	6	3	3	6	3	4	5	5	7	4	5				

**Fig. 4** Synopsis researcher survey/direct project area—company survey: Knowledge and attitudes concerning artificial intelligence; *RD* researcher survey-direct project area; *CS* company

**Abb. 4** Synopse Forschendenbefragung (direkter Projektbereich)/Unternehmensbefragung: Wissen und Einstellungen zu Künstlicher Intelligenz; *RD* Forschendenbefragung (direkter Projektbereich); *CS* Unternehmensbefragung

Item	Company Nr.																Arithm. Mean		Total N	
	1	2	3	4	5	6	7	8												
<i>Empl.=Employees</i> <i>DSP=Direct Supervisor Person</i> <i>/h: high value=high rank;</i> <i>/l: low value=high rank</i>	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS	RD	CS
RS: DSP sensitizes empl. for change/I CS: MeanInd. DSP sensitizes for change/h	--	6	2	3	6	2	2	1	1	5	5	8	4	7	7	4	1,81	3,00	17	173
RS: DSP responsive to interests of empl./I CS: MeanInd. DSP appr. to interests/h	--	6	2	4	6	3	4	1	3	5	5	8	1	7	--	2	1,25	3,09	19	174
RS: Empl.'s team works in spirit of trust/I CS: MeanInd. Teamwk. in spirit of trust/h	5	6	1	3	5	3	1	1	4	3	8	8	1	7	7	2	1,65	3,27	23	173
RS: Positive error culture in the team/I CS: Positive error culture in the team/h	--	7	1	4	5	5	3	1	1	3	7	6	4	7	6	2	1,44	3,18	17	174
RS: Empl. are given responsibility by DSP/I CS: DSP delegates tasks/h	5	5	1	3	5	4	2	1	5	7	5	6	3	8	4	1	1,67	3,30	21	168
RS: Empl. can play active role in comp./I CS: I can play an active role in company/h	5	4	2	5	7	6	1	1	3	2	5	7	4	7	8	3	1,78	2,95	24	164
Rank averages (rounded to whole numbers)	5	6	2	4	6	4	2	1	4	4	6	7	3	7	7	2				

**Fig. 5** Synopsis researcher survey/direct project area—company survey: Corporate culture; *RD* researcher survey-direct project area; *CS* company

**Abb. 5** Synopse Forschendenbefragung/Unternehmensbefragung (direkter Projektbereich): Unternehmenskultur; *RD* Forschendenbefragung (direkter Projektbereich); *CS* Unternehmensbefragung

vey on the other. However, there are some differences and general conditions that need to be considered when interpreting the contrasted results. This starts with the different scales used: in the researcher survey, a five-point Likert scale from 1 “Yes/Totally True” to 5 “No/Not True”; in the company survey, four levels from 1 “No/Not Applicable” to 4 “Yes/Fully Applicable”. The arithmetic mean values reported below cannot therefore be directly compared, but this also appears to be methodologically problematic against the background of the different reference values. In this sense, the comparative results—albeit obtained by quanti-

tative means—must be interpreted qualitatively to a certain extent.

Figure 3, 4 and 5 compare the results of the company survey to the researcher survey concerning direct project areas. Where suitable, selected results from researcher survey, entire site, are added in the text.

It should be noted that the scale of the average attitude towards electronic devices ranges from 1 = very negative to 5 = very positive. The remaining items are scaled from 1 = “Yes” or “Fully applicable” to 5 = “No” or “Not applicable”. For item content with a negative affinity for

technology, such as “Concerns about the health effects of electronic devices”, a high value means a high affinity for technology, while for positively polarized item content such as “Interest in new electronic devices”, a high affinity for technology is characterized by a low value. Accordingly, the ranks are assigned in the direction of high technical affinity, i.e. for example: the highest value for “Concerns about the health effects of electronic devices” received rank 1, the next higher rank 2, etc. For positively polarized items, rank 1 was awarded for the lowest value, etc.

Following Fig. 3 the researchers estimate the affinity for technology of those directly involved in the project to be slightly higher than indicated by the employees in the company survey—the mean value there is slightly further away from the maximum value of the scale ( $4.00 - 2.93 = 1.07$ ;  $1.07/4.00 = 0.125$ ; in the same way, the distance value for the researcher survey scale is 0.268). With more methodological caution, it can at least be stated that both values are on the (rather) tech-savvy side of the respective scale. The researchers estimate a lower average attitude (Arithmetic mean (AM) = 3.95,  $N = 15$ ) towards electronic devices for the entire site which better meets the company survey results. For both areas, researchers clearly underestimate the concerns of employees regarding the health effects of electronic devices (AM = 4.61 for the entire site) as well as effects on social contacts (AM = 4.25 for the entire site). Accordingly, the interest in new electronic devices is overestimated both in the direct project area and company-wide (AM = 2.10 for the entire site).

The corresponding question to “Confidence to cope with electronic devices” in the researcher survey was given a stronger connotation in the direction of AI (“Do employees think they can cope with digitalization and AI?”), as this is of great interest regardless of the comparison with the company survey. Both mean values are in the positive scale range and certainly cannot be directly compared, but they speak for a general openness of employees to digital technologies and, at least in the project area, also to AI. The researchers hardly distinguish between the direct project area and the company as a whole (AM = 1.67 for the entire site). The status and benefits of electronic devices are more strongly affirmed in the company survey, especially the role of status is even more underestimated in the sitewide view of the researchers (AM = 3.60 for the entire site). In U5, U6 and U8, the researchers observed a lower affinity for technology (overall and in essential components) than in the other corporate partners, but for U5 the company survey does not reflect this to the same extent. In the case of U8, it is noticeable that the status and benefits of electronic devices are viewed least positively in the company survey. Whether this creates a need for action in the context of digitization projects must be clarified based on the absolute survey values.

The researchers see the knowledge about AI in the middle of the field in the direct project area across all companies. The assessment of low company-wide knowledge of AI (AM = 4.39) is more consistent with the information provided by employees. Surely, the increase in knowledge through project participation could play a role. The researchers estimated the proportion of employees who have already used AI to be higher than the company survey shows. This applies to the project area as well as to the entire site (AM = 1.75). One reason could be that not all users are aware that they are using “AI-containing” apps on their smartphones, for example.

According to the researchers’ observations, fear of AI almost does not seem to come to light in the direct project area and beyond as well. The company survey provides an average value in the range of “rather no”, with U1 and U2 at the end of the ranking. For concerns about being replaced by AI, the same applies to U3, U7 and U8. Employees tend to view the changes in work caused by AI as positive, while the researchers suspect a somewhat more positive view of the project area as well as of the overall location (AM = 1.76). Further, researchers assume somewhat less awareness of the strength of the expected changes throughout the company (AM = 3.13); the difference is even larger in the company-wide view. According to the company-wide ranking, the workforce of U1 is more realistic than the researchers’ assessment (rank 4 for the entire site), and less fearful than assumed that AI could replace their work (rank 8 in researcher survey for the entire site). For U4, the rankings of the researcher survey and company survey are only significantly different in the item “Already using AI”, while for U3, U5, U7 and U8 there are considerable differences between the rankings from the two surveys.

The corporate culture, which is in the positive range of the scale across all companies in the company survey, has higher missing rates among employees than the questions discussed so far. The same applies for the researcher survey, especially company-wide. Looking at the distances from mean values to maximum values of the scales again, the assessments of the researchers in the direct project area are consistently somewhat more positive than those of the employees in the company survey. Company-wide, the trends are quite consistent as well—the opportunities for participation are seen somewhat better by the researchers across the companies (AM = 1.62) than in the company survey. Further they presume that employees are less informed about the project than in the direct project area (AM = 2.95 for the entire site).

Uniformly, the highest ranking agreement on the questions about direct superior, trust and positive error culture in the team as well as the possibility of participation can be found in company U4 for the direct project area, whereas company-wide rankings are the most consistent for U6



(Direct Supervisor Person (DSP) sensitizes employees for change: rank = 7; DSP responsive to interests of employees: rank = 6; Employee's team works in spirit of trust: rank = 6; Employees can play active role in company: rank = 7). The researchers see U7 and U2 as partly further ahead for the direct project area as well as—even stronger deviant—the company site (U2: rank = 2; U7: rank = 2) in comparison to the company survey.

The employees of U4 and U8 see their corporate culture somewhat more positively than the researchers perceive it in the project area as well as company-wide (U4: rank = 2; U8: rank = 4). However, for the entire site, the researchers made only two assessments concerning the corporate culture of U8, namely for “DSP sensitizes for changes” and “Positive error culture in team”. In the only question about trust in the team that was answered at all, the company-wide researcher assessment (rank = 5) roughly matches the ranking of the company survey for U1.

Finally, we outline the perceived collaboration between the researchers and the company representatives in the project. These items presented in Fig. 6 have no equivalent in the employee survey.

In the direct project area, U1 leads the perceived quality of cooperation together with U7. The interest in the project, openness towards the project partners and active participation as well as the willingness to contribute with suggestions are all equally the highest ranked. U1 and U7 are followed by U4 in the overall ranking. U6 is experienced as the most reluctant to cooperate; U3 and U5 are also not among the pioneers of active project cooperation. Again, in view of the mean values in the range “applies” with a tendency towards “rather true”, this does not mean that the cooperation with these partners is dysfunctional, but that U1, U7 and U4 stand out particularly positively.

Pointing out some aspects of the results, it is noticeable that the workforce in the companies is characterized by a high proportion of men and a predominant proportion

of employees aged 45 and over. Following the observation interviews, the job activities to be supported by AI were depicted as technically demanding. Four of the five interviewees emphasized the great importance of empirical knowledge. Overall, the research activities in WIRKsam are met with openness to electronic devices, but also with a consistently positive expectation of self-efficacy when dealing with AI.

Concerns about health or social disadvantages in the context of electronic technologies, fear of AI itself or of being replaced by it are only very moderate, but it is important to realize that these fears are somewhat underestimated by researchers. It is advisable to raise awareness among the research team in this direction. The discrepancies between researchers and employees in the assessment of the level of AI knowledge and experience with AI applications are noteworthy. With the discussion and learning format “ai@your fingertips”, WIRKsam is currently addressing this topic—in the first step, mainly among the managers involved in the project. Shop floor employees can also benefit from this in terms of appropriate self-assessment and qualification.

A few highlights can illustrate the derivation of further possible measures. For example, employees in U1 and U3 are most concerned about health or social disadvantages of electronic technologies, while at the same time in U1 there is most fear of AI technology itself and in U3 fear of being replaced by AI. In the assessment of corporate culture, both are in the middle of the field. As a measure for a more relaxed view of AI, addressing knowledge deficits and “demystifying” AI with regard to ascribed properties seem suitable. In U7, too, there are fears that AI will replace human work. The workforce is one of those who expect the fewest changes in work in a positive sense, but also overall. In terms of corporate culture, U7 is at the bottom of the ranking, supplemented by the corresponding reference from the observation interview.

**Fig. 6** Researcher survey: Co-operation in project

**Abb. 6** Forschendenbefragung (direkter Projektbereich): Kooperation im Projekt

Item	Company Nr.								Arithm. Mean	Total N
	1	2	3	4	5	6	7	8		
<i>Empl.=Employees</i> <i>Lowest value: Fully applicable</i>	D	D	D	D	D	D	D	D	D	D
The empl. actively participate in meetings with the research partners	1	1	7	1	5	8	1	5	1,51	25
The employees are open to research partners	1	1	5	1	7	8	1	6	1,47	25
The employees make suggestions for solutions	1	4	6	3	6	8	1	5	1,47	23
The employees show interest in the project	1	5	5	1	7	8	1	1	1,46	25
Rank averages (rounded to whole numbers)	1	3	6	2	6	8	1	4		

According to the PASST's findings on the importance of being a role model on the part of the company and an error-friendly corporate culture when introducing technology, this could help to improve the success of the project.

## 4 Discussion

The paper specifically focuses on understanding how organizational factors such as technology acceptance, access to IT-supported work tools, corporate culture and employee structure present themselves in interaction in companies that want to design AI-supported work systems, and how the knowledge about them can be used to positively influence the successful implementation of AI technologies.

### 4.1 Discussion of the results

In general, it is essential for us to emphasize that, as shown by the arithmetic averages of the indices and items reported across all enterprises, the WIRKsam companies are generally on a solid, possibly expandable stand.

Three points should be singled out here.

First, for a project collaboration that aims at human-centered work system design, it seems important that the researchers reflect on their perspectives on the application companies and their employees and base them on data and facts, because this determines how they shape the cooperation. Our results show, for instance, that researchers underestimate some worries and reservations of employees concerning AI. If employees are expected to be partners on an equal footing in system development, the background for their preferences and decisions should be clear to avoid suboptimal decisions. Especially fear of AI as well as concerns about being replaced by AI could put a strain on employees and affect their acceptance of the new systems. The measured moderate level seems not to indicate an urgent problem for the WIRKsam companies. However, since this point is so crucial for dealing with AI it is advisable to be sensitive, especially concerning the companies at the end of the ranking.

Secondly, for eight companies with very different numbers of employees, the database is not sufficient for a serious categorization. However, there are indications that could be followed up in a larger-scale study. For example, there are apparently companies whose workforces are concerned about various effects of generally electronic or AI technologies. This can, but does not have to be accompanied by deficits in the corporate culture. It is important to separate these in order to take targeted measures. Knowledge about AI can allay fears. However, if there is a lack of trust in company management, training is necessary but not sufficient. Following the results of PASST, the support and role

model function of the company management are very important factors for the introduction of the technical system from the point of view of the employees.

Third, the results support the thesis that a participatory, human-centered design of the new work system using organizational and skill-related options helps employees find their role in AI-supported work processes. As shown in PASST, employees tend to wish to be involved; additionally, certain aspects of technology—reliability of use and simplicity of use—are crucial from their perspective for a successful integration into the work system (cf. Altepost et al. 2024). The participatory framework offers them the opportunity to exert influence on these topics. If employees can contribute their benefits to the development and purchasing decisions of technologies, it should be possible to dispel any reservations. Otherwise, serious health effects can arise. As Stamer notes, psychological illnesses increase when employees' needs are not considered as well as if there is a lack in communication, information and transparency (Stamer 2021). Attention should also be paid to the limitations of the confidence expressed by employees to cope with new technologies. Researchers may be too optimistic about this. These concerns can be addressed, for example, through personal experience in participation and training measures. However, a stronger involvement of employees of upstream and downstream processes as well as specialist departments (e.g. sales, human resources, IT) could not only give researchers insights beyond the project area, but also advance the redesign of the work system and dovetail the project area and the surrounding company to the project issues. A later transfer to other areas of the company is likely to benefit from this. The identification of stakeholders may have been completed ahead of schedule in one company or another. This could be remedied, for example, by a network analysis at the beginning of the project. The associated time and personnel expenditure can be compensated for in the internal transfer of the project results if this is considered during stakeholder selection.

### 4.2 Discussion of the methodology

A mixed-methods approach is utilized to identify conducive factors in application companies by comparing initial framework conditions with experiences and assessments over at least 24 months of project work from the perspective of the researchers involved. The methods are combined in the sense of triangulation and the intention to approach a comprehensive profile of the company which then can be matched to measures, e.g. in the field of qualification, in the process of an AI project.

The empirical instruments must be critically reflected regarding their validity. Limitations in this regard may already be inherent in the survey which is a known methodologi-

cal problem in survey and interview methodology, particularly the phenomenon of social desirability (e.g. Schnell et al. 2023; Stocké 2014, pp. 624–625). For this reason it is interesting to contrast the employees' statements with the researchers' knowledge gained during the project. Valid feedback on these questions is one of the conditions for the success of AI projects, as the measures of the process model must be individually adapted depending on the status of the framework conditions. Some methodological topics, as assessing comparable samples or simplifying complex instruments as "PASST" in order to avoid nonresponse, have to be aggregated to a comprehensive methodological concept involving more insight for the researchers into company circumstances as well as the employees into project features right from the start of a human-centred AI introduction project.

Additionally, it should be noted that the contrast of the researchers' impressions with the employees' statements can only be made at an aggregated level. Although the researchers' statements mainly refer to individual persons, such personalized responses of a researcher cannot be assigned to the statements of the respective person since the survey was conducted anonymously for reasons of acceptance. As the results show, the researchers have little insight into the divisions of the company outside the direct project area. A methodological design that includes a researcher survey from the outset could mitigate this problem. In the case of WIRKsam, the empirical instruments were not designed for a later overall consideration with the researchers' assessment. If such an analysis is planned from the outset, the reference groups and questions can be better coordinated with each other in a more methodological and systematic manner. Nevertheless, the methodological ideal case of interviewing a precisely identifiable group of people and being able to observe them systematically will rarely be feasible in projects with industrial companies.

For reasons of data protection vis-à-vis the companies, the triangulation of the surveys with other instruments such as observational interviews and workforce structure analysis could only be shown in an exemplary and vague way. In explicit terms beyond the ranking presented here for data protective reasons, the data offer powerful tools for assessing the situation in the company. So this situational base can be addressed in terms of employee needs and turned into a frame which allows organizational change that is driven forward by all those involved—management and employees alike. We hope to have given an impression of this.

Now, contrasting the responses could raise the question of which of the disparate statements—those of the employees or those of the researchers—should be taken as "truly valid". Depending on the context, our answer is: both. Drawing on the sociologist Schulz-Schaeffer, the knowledge of experts and laymen should not be understood as

complete in the former case and fragmented in the latter. Rather, we differentiate two forms of knowledge which serve different purposes (Schulz-Schäffer 2000, p. 219). In turn, this creates room for different perspectives and interpretations.

To obtain the desired empirical base for a successful, human-centered design of AI-supported work systems, it is therefore not a question of identifying a "correct" perspective, but rather of jointly determining valid results in the sense of shared views on the initial conditions and objectives for the respective use case.

## 5 Summary

This paper examines the organizational framework conditions necessary for the successful, human-centered introduction of artificial intelligence in workplaces. This aligns well with ergonomics as it investigates how technology can be implemented to complement human work, focusing on technology acceptance, work design, and organizational framework conditions. The article presented the various instruments used in WIRKsam to generate important data for assessing the company's framework conditions for working with AI. The focus was on surveys of employees on the one hand and researchers on the other hand on the same questions from the areas of technology affinity, electronic devices, knowledge and attitudes towards artificial intelligence, as well as corporate culture and participation in a synopsis. All in all, the WIRKsam companies are well-positioned application partners with quite different profiles and—at an overall high level—individual strengths in technology and AI affinity as well as corporate culture. Starting points for further improvement of the project conditions have already been mentioned in the discussions on the results. The WIRKsam team is currently working on the implementation of the results in concepts for the further change process, i.e. ultimately the tailor-made application of the WIRKsam process model. For example, if a company has a weak culture of participation, employees must be prepared for participation in technology development through targeted training measures. Further details will be provided shortly as recommendations for action.

For data protection reasons, the interaction of the instruments can only be presented imperfectly in the context of a publication, as it quickly affects internal company conditions. However, during projects—and this is at least partially shown by the rankings—the activity and self-evident nature of the cooperation with employees shows the extent to which participation is part of everyday life in the company. Here, the companies have very different traditions and opportunities based on their size, staffing, organization or hierarchies or even possible external regulations. With the



HTO concept and an appropriate time horizon, areas for action can be developed to provide an appropriate framework for participatory work system design.

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