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The European Journal of Workplace Innovation (EJWI) is an open-access, net-based, peer reviewed and English-language journal. The Journal invites research-based empirical, theoretical or synoptic articles focusing on innovation and workplace development.

The aim of the journal is:

- To develop insights into workplace innovation
- Provide case studies from Europe as well as comparative studies from other continents
- Develop and present new theories in the field of workplace innovation
- To increase international publication within the field
- To become an important publication channel for workplace innovation researchers as well as the international research community.

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Editorial

Workplace Innovation in the Conditions of Real Work

Egoitz Pomares

Workplace Innovation is usually discussed at the meeting point between organisational improvement and the quality of working life. It concerns dialogue, participation, productivity, adaptability and performance, but it also draws attention to the knowledge and experience of people at work.

The contributions to this issue of the *European Journal of Workplace Innovation* approach this meeting point from different settings: a textile SME, a warehouse, Finnish and Swedish public organisations, and the wider debate on Industry 4.0 and Industry 5.0. Their empirical and conceptual concerns differ, but they can be read together around a shared question: how does innovation take shape when it enters the conditions of real work?

The issue therefore does not treat innovation as a fixed object. A tool may be introduced, a reform may be launched, a process may be redesigned, or a technology may be adopted. Yet the meaning of innovation is shaped by what happens as these initiatives encounter everyday work: how they are organised, interpreted, adapted, supported, or made difficult by existing routines, structures and demands.

In *Two Ways to Rome – A Comparative Study of Digital vs. Analogue Open Workplace Innovation Processes*, Aline Lohse, Stefanie Rockstroh, Leonardo Puricelli, Sophia Worbes, and Angelika C. Bullinger-Hoffmann examine whether digital participation can support workplace innovation in ways comparable to analogue participation. Their study, set in a textile SME, points to a careful but relevant observation: the format alone does not appear to determine the quality of the participatory process. Digital and analogue formats each depend on how participation is organised, how employee knowledge is gathered, and whether contributions are translated into design decisions. The article therefore contributes to current discussions on participation in SMEs without reducing the question to a simple choice between digital and face-to-face methods.

A related concern appears in *Reframing Success in Embodied Work: Competing Perspectives on Occupational Exoskeleton Adoption*, by Veronika Bak, Dr. Jason Pridmore, Dr. Andy Sanchez and Chantal Ho. Here, the workplace technology is not a dashboard or a digital platform, but an occupational exoskeleton worn on the body. The article brings the bodily and practical conditions of use into the discussion of technology adoption. Through the Normalisation-Situated Practice Matrix, the authors examine how formal organisational embedding and

workers' situated engagement may align or diverge. Exoskeletons are not adopted only through plans, procedures or metrics; they are worn, adjusted, discussed, tolerated, refused or reworked in practice. The article offers a way of considering technology integration without reducing it to acceptance or resistance.

The following two articles turn to public-sector change, where workplace innovation is shaped by reform pressures, professional cultures, administrative systems and the everyday demands of service provision. In *Leader Change Engagement as a Boost for Workplace Development*, Satu Uusiautti and Krista Rautio focus on leaders in a Finnish Wellbeing Services County. Their article directs attention to leaders' own experience of change. Leaders are often expected to support, translate and sustain organisational reforms, but their engagement depends on the conditions in which they work. Role clarity, autonomy, communication, participation, support and time emerge as important resources. The article adds a useful perspective to workplace development by considering leaders not only as agents of change, but also as people working within change.

Anna Fogelberg Eriksson and Agneta Halvarsson Lundkvist continue the public-sector focus in *Conditions for Workplace Innovation in a Public Organisation - A Domino Effect of Emerging Barriers*. Their longitudinal study of a Swedish municipality follows an innovation process from development and testing towards implementation. In the early phases, political support, change leaders, collaborative arenas and interprofessional teamwork created opportunities for learning. As the process moved towards wider implementation, other conditions became more visible: organisational silos, budget structures, administrative systems, professional logics, staffing problems, time pressure and weakened mandates. The article is attentive to how barriers emerge and interact over time, and to how implementation may require renewed learning rather than the simple transfer of an already completed idea.

The Forum contribution by Hartmut Hirsch-Kreinsen, *The Challenge of Socio-Technical Work Design: An Essay on the Open Issues of Industry 4.0 and Industry 5.0*, places these questions within a wider debate on socio-technical work design. Hirsch-Kreinsen revisits the relationship between Industry 4.0, Industry 5.0 and human-centred work. His essay reminds us that work design is not only a matter of tasks, tools and interfaces. It is also shaped by sectors, labour markets, institutional arrangements, economic pressures and political priorities. The contribution gives the issue a broader frame, while also introducing caution about the limits of design concepts when they are detached from wider structural conditions.

Seen alongside one another, the contributions do not produce a single model of workplace innovation. Rather, they open a set of related questions. How is participation organised so that it becomes meaningful? How do technologies meet the bodily, practical and social realities of work? What enables leaders to remain engaged during major organisational reforms? What happens when implementation encounters silos, budgets, administrative systems and professional boundaries? And how are ideas of human-centred work shaped by wider industrial and institutional conditions?

These questions are particularly relevant in a European context in which organisations are being asked to become more digital, more sustainable, more resilient and more efficient. Public organisations face growing needs and limited resources. Industrial firms are navigating technological and economic transformation. Workers and leaders are expected to adapt while continuing to deliver quality, care, safety and productivity.

The value of this issue lies in keeping these questions grounded. It brings workplace innovation close to the settings in which it is attempted, negotiated and revised. Across the articles, innovation appears not as a finished outcome, but as a process situated in work itself: in participation, use, leadership, collaboration, implementation and design.

Workplace Innovation, in this sense, remains a practical and open field of inquiry. Its conditions vary, its paths are uneven, and its meanings depend on the people, organisations and institutions through which it unfolds.

Two Ways to Rome

A Comparative Study of Digital vs. Analogue Open Workplace Innovation Processes

Aline Lohse
Stefanie Rockstroh
Leonardo Puricelli
Sophia Worbes
Angelika C. Bullinger-Hoffmann

Abstract

This paper examines the implementation of workplace innovation (WPI) in a small and medium-sized enterprise (SME) in the textile sector by comparing a participatory approach conducted in analogue and digital formats. It addresses the question of whether, in SMEs with limited innovation resources, digital participation can enable outcomes comparable to those of analogue formats. The textile industry provides a relevant empirical context, as it faces both innovation- and sustainability-related challenges, such as the need to reduce waste and improve production efficiency while adopting new technologies.

In the study, employees participated in digital or analogue focus groups and contributed their perspectives to the design of paper-based dashboard prototypes for the cutting machines they operated. The evaluation focused on the acceptance of the focus groups, perceived WPI, and the usability ratings of the resulting paper-based dashboard prototypes. The descriptive findings did not indicate substantial differences between digital and analogue focus groups with regard to acceptance and perceived WPI. Likewise, the usability ratings of the paper-based dashboard prototypes showed only limited descriptive differences.

Overall, the study suggests that, under certain organisational conditions, digital participatory formats may represent a viable option for implementing WPI in SMEs. The findings indicate that the key issue lies less in the format itself than in how participation is designed and enabled within the organisational setting.

Given the single-case design and descriptive analysis, the generalisability of the results remains limited. Further research is needed to compare digital and analogue WPI processes systematically under standardised conditions.

Keywords: SME, Workplace Innovation, Open Workplace Innovation, digital participation, employee participation

Introduction

Employees operating machinery in SMEs are confronted with increasing amounts of data and heightened mental workloads, both of which intensify performance demands. Each machine or component may involve distinct software systems and operational requirements that employees must continuously monitor, while critical information is often provided in real time, creating the risk of information overload and increased stress levels among employees. The ongoing digitisation of manufacturing environments is introducing increasingly complex machines and procedures, thereby creating substantial challenges for employees (Gao et al., 2019; Snatkin et al., 2015). The COVID-19 pandemic further accelerated changes in workplace structures and has been linked to negative effects on well-being (Giorgi et al., 2022). Research indicates that new technologies may intensify work and be associated with adverse health outcomes such as elevated stress levels and emotional exhaustion (Dengler & Tisch, 2020). As a result, it is becoming increasingly difficult for employees to maintain an overview of relevant parameters and respond effectively.

The Job Demands-Resources Model posits that an escalating workload represents a job demand that can result in heightened strain and diminished job performance, yielding repercussions for individual employees, such as burnout (Demerouti et al., 2001), and potentially an elevated risk of non-fatal injuries in SMEs (Hilton & Whiteford, 2010). In addition, heightened job demands may negatively affect organisational outcomes such as productivity (Nurmasari et al., 2018; Sari et al., 2018). To mitigate these adverse effects, reducing employees' cognitive load is essential. Improved human-machine interfaces can help to alleviate mental workload while enabling employees to focus on the most relevant parameters (Wickens et al., 2021). In this study, paper-based dashboard prototypes providing critical information were developed for the cutting machines. Their technical implementation adjacent to the machinery was not feasible within the project period, so the evaluation remained limited to paper-based prototypes. The underlying objective of reducing employee strain while supporting organisational goals such as productivity is therefore highly relevant.

WPI provides a promising framework for aligning employees' well-being and organisational performance (Oeij et al., 2023; Kesselring et al., 2014). The advantages of this approach are extensively documented and include heightened profitability, greater customer satisfaction, and improved employee motivation (Oeij & Vaas, 2016; Pot, 2011).

In light of growing economic pressures on SMEs, we must also consider the relevance of WPI beyond employee health and well-being. Recent evidence shows that German SMEs continue to face difficult economic conditions (Schwartz & Gerstenberger, 2025), while innovation activity remains under pressure, particularly among smaller firms (Zimmermann, 2025). In this context, the effective use of technological opportunities becomes increasingly important, especially where firms operate with limited innovation resources. At the same time, high energy and production costs have become a major factor affecting competitiveness for companies in Germany and Europe, leading to challenges in maintaining profit margins and investing in innovation (Schwartz & Gerstenberger, 2025). In addition, geopolitical tensions,

stricter trade rules, and the growing fragmentation of global value chains have made international trade conditions less stable (European Central Bank, 2024). Under these conditions, the question is not only whether digital technologies can be adopted but also whether they can be implemented in ways that support effective, feasible, and resource-conscious innovation processes in SMEs. This makes the design of participatory approaches particularly relevant for examination, as SMEs require innovation processes that are not only acceptable to employees but also workable under constrained organisational conditions, such as limited budgets and staffing resources (Zimmermann, 2025).

For SMEs, the concept of open innovation (OI), defined as the integration of external and internal ideas (Chesbrough, 2003), is particularly relevant because these firms often face resource constraints. Participation in OI enables SMEs to collaborate with different stakeholders and thereby foster innovation (Hossain & Kauranen, 2016; Franken & Franken, 2020). Open Workplace Innovation (OWPI) can be conceptualised here as a promising strategy, combining external impulses with the active involvement of employees in the innovation process.

The COVID-19 pandemic has also shaped the context in which firms pursue technological and organisational innovation. In Germany, it was associated with declining demand, supply chain disruptions, and production stoppages, resulting in considerable economic contraction (Hutter & Weber, 2020). At the same time, it accelerated the uptake of digital innovations such as remote work and online communication, thereby increasing the relevance of digital forms of collaboration and participation (Giorgi et al., 2022; Bertschek, 2020). This development provides an opportunity to compare established analogue forms of participation with digital approaches that gained prominence during and after the pandemic.

Against this background, the present study examines the comparative application of a participatory approach in analogue and digital form in the context of WPI in a German textile manufacturing SME. More specifically, analogue and digital focus groups were conducted with machine operators in order to develop paper-based dashboard prototypes for the machinery they operate. The study investigates whether the two participation formats differ with regard to acceptance and perceived WPI-related outcomes and, in doing so, shifts attention to the question of how participatory processes need to be designed in SMEs under conditions of digital transformation.

Theoretical Background

Mental workload is similar to physical workload in that it refers to the demands on the central nervous system's limited processing capacity (Wickens et al., 2021). The increasing expectations placed on individual employees to maintain a comprehensive understanding of the increasingly complex machinery they operate can be framed as mental workload, ultimately resulting in cognitive and physical strain (Schuette & Koeper, 2013). The Job Demands-Resources Model (JD-R, Bakker & Demerouti, 2017) identifies excessive mental

workload as a job demand, defined as "[a] physical, psychological, social, or organisational aspect [...] of the job that require[s] sustained physical and/or psychological (cognitive and emotional) effort or skills and [is] therefore associated with certain physiological and/or psychological costs" (Bakker & Demerouti, 2007: p. 312). Such demands can lead to job strain and adversely affect job performance. This conclusion is consistent with findings showing that psychosocial working conditions are linked to adverse health-related outcomes, with distress, work satisfaction, and work ability acting as relevant mediating mechanisms (Van Hoffen et al., 2020). Increased job demands lead to job strain and fatigue, which constitute core elements of burnout (Demerouti et al., 2001). Furthermore, research indicates that heightened workload as a job demand may influence organisational outcomes, including productivity (Nurmasari et al., 2018; Sari et al., 2018).

The JD-R model proposes minimising job demands and augmenting job resources to enhance organisational outcomes. In this article, the newly developed paper-based dashboard prototypes are conceptualised as design artefacts intended to address mental workload as a job demand. Since employees engaged in focus groups and actively participated in the development of the dashboard concepts, the process can be interpreted as addressing elements of social support and autonomy as job resources, potentially mitigating the adverse effects of high job demands on exhaustion and strain (Bakker & Demerouti, 2017). In this sense, the study combines the design of a potential technological support tool with the enhancement of job resources through participation. The design of the dashboard prototypes specifically targets the reduction of obstructive job demands (Tims et al., 2022). In this study, new paper-based dashboard prototypes were designed to address job demands while also increasing job resources, such as autonomy, through participatory development (Ong & Johnson, 2023).

In the context of digitally mediated participation, however, work design factors alone may not fully explain employees' experiences, as individual predispositions towards technology may also play a role. One potentially relevant construct in this regard is affinity for technology interaction (ATI). ATI, introduced by Franke et al. (2019), refers to an individual tendency to actively engage with and enjoy interacting with technology. It may therefore be particularly relevant in contexts in which participation is mediated through digital tools rather than face-to-face interaction. Conceptually, ATI may be related to Need for Cognition (Bless et al., 1994), as technological interaction frequently entails cognitive engagement and problem-solving. In the present study, ATI is included as an exploratory individual-level factor that may help explain employees' acceptance of the digitally mediated participation format. Considering ATI may therefore provide additional insights into how digitally mediated participation is perceived and accepted.

Research on WPI has intensified recently, revealing a plethora of interpretations and applications within both theoretical frameworks and practical settings. This plurality is also reflected in foundational contributions that frame workplace innovation as a multidimensional field of theory, research, and practice rather than a single uniform concept

(Oeij et al., 2017). Oeij et al. (2023) categorise the discourse into various domains, including sociology and organisational studies, safety science and organisational research, economics, strategy and human resources, and psychology and behavioural studies. While these distinct streams of thought occasionally intersect, they collectively strive towards a "good job strategy" (Oeij et al., 2023, p. 216). Frequently, WPI is defined through its intended positive outcomes, such as heightened productivity or enhanced employee satisfaction (Kesselring et al., 2014), which makes the concept difficult to delineate and assess consistently across studies. The authors argue that WPI has been discussed as a useful framework for addressing current disruptive transitions, such as the COVID-19 pandemic, the climate crisis, and digital transformation. Oeij et al. (2023) assert that workplace dynamics influence broader aspects of life, emphasising the necessity for collaborative approaches among organisations and managers. This collaborative effort is facilitated through the implementation of WPI practices.

The theoretical understanding of WPI significantly contrasts across different research approaches, reflecting a divergence in applied research questions and designs. Predominantly employed methodologies include cross-sectional studies and questionnaires (Oeij et al., 2023; Newnham, 2021; Stoffers et al., 2021). In contrast, the third European Company Survey (Eurofound, 2015) employed interviews with managers, employees, and employee representatives, showcasing an alternative methodological approach. However, research actively promoting WPI practices and investigating their implementation within specific organisations remains scarce. Only a minority of studies have implemented some form of intervention (Rom & Green, 2023; Lebesby et al., 2023). This gap between conceptual discussions and practical implementation has been identified as a persistent problem in WPI research (Totterdill, 2015). Recently, WPI research has been characterised as fragmented, with the pursuit of a "good job" strategy suggested as a constructive objective across various research strands (Oeij et al., 2023). Especially for SMEs navigating the complexities of digital transformation, research that enhances the implementation of WPI practices could prove beneficial because it may provide practical frameworks and strategies for addressing the specific challenges. Against this background, digital tools in manufacturing should be viewed not only as technical artefacts but also as elements of broader work system design and human-technology interaction (Wischmann, 2015). To the best of our knowledge, research on the adoption of WPI practices employing digital methods is limited.

The literature (Love & Roper, 2015) has thoroughly examined the distinct challenges SMEs encounter regarding innovation. From an open innovation perspective, these challenges are particularly relevant, as innovation in SMEs often depends on the ability to integrate knowledge, ideas, and impulses beyond formalised internal R&D structures (Bigliardi et al., 2020). These challenges often stem from limited financial and human resources, resulting in diminished capacity to prioritise innovation amidst the pressing demands of daily operations. Consequently, innovation processes may lack structure and organisation, further impairing internal capabilities (Hossain & Kauranen, 2016). In many cases, improvements and innovations are spurred primarily by complaints or failures, suggesting that innovation often remains reactive rather than proactive. Even so, innovations are crucial for fostering

economic advancement and growth (Prettner et al., 2018). However, there is a dearth of studies investigating various forms and success factors of innovation within SMEs (Hauschildt et al., 2022). Typically, product innovation is systematically integrated into SME practices, while other forms, such as process or social innovations, are not adequately addressed. Without the appropriate allocation of resources and authority, innovation efforts are likely to be overshadowed by established routines (Hauschildt et al., 2022).

In contemporary contexts, a significant number of these innovations incorporate digital components, such as new software for bookkeeping or enhanced communication tools, including chat applications (Arnold et al., 2016; Lindner et al., 2017). Despite these advancements, only 20 % of SMEs have initiated the digital connection of products and services, with the majority reluctant to invest more than €10,000 annually in innovation efforts. To bring about lasting change, it is necessary to take small, steady steps over time (Saam et al., 2016). Many SMEs perceive ongoing digitalisation as a vital opportunity to reposition themselves within the market; thus, a widespread digital transformation of company processes is imperative for most organisations (Holtkamp, 2019). In this sense, the adoption of WPI practices would reconceptualise innovation as an ongoing process (Kesselring et al., 2014), characterised not by a finite end product but by ongoing and interrelated practices that organise the innovation process (Howaldt et al., 2015) while accounting for the "inseparability of the human, organisational and technical dimensions" (Lohse et al., 2020, p. 421).

In this paper, we argue that WPI must actively engage those impacted by its outcomes, specifically the employees who operate the machinery. Consequently, the design and content of the dashboard concepts should be determined by these employees, while systematic expertise, particularly regarding the methodologies for gathering and synthesising their feedback, can be introduced through collaboration with external partners, such as researchers in this study. This approach can be understood here as reflecting an OWPI perspective that integrates the objectives of WPI, including stakeholder involvement and the fulfilment of both organisational and employee needs, with OI principles that leverage external ideas and knowledge.

In this context, WPI draws on both methodological expertise and employees' practical knowledge of work processes, thereby contributing valuable practical insights into the requirements for a dashboard. Enhanced autonomy, increased social support, job crafting, and diminished job demands may positively affect motivation and job performance and may help mitigate exhaustion (Bakker & Demerouti, 2017). These anticipated outcomes, along with the overarching advantages of WPI (Oeij et al., 2023), underscore the merit of implementing a WPI approach.

This study is primarily focused on comparing analogue and digital formats for conducting the WPI process. In doing so, it addresses a gap in WPI and OWPI research. While prior work has highlighted the relevance of participation, comparatively little attention has been paid to the

format through which participation is organised and experienced in SMEs. This is particularly relevant for SMEs, where resource constraints, limited formalised innovation structures, and operational pressures make the design of feasible and effective participatory processes especially consequential. The COVID-19 pandemic has catalysed the exploration of digital solutions, which may present a flexible and potentially cost-effective alternative, but it remains unclear to what extent format-related differences matter once employee participation is meaningfully designed and embedded.

Consequently, our research question is, "Do digital and analogue participatory methods lead to similarly positive assessments of acceptance and perceived workplace innovation?" This, in turn, informs the question of how WPI can be implemented in SMEs under conditions of digital transformation. To structure the exploratory comparison of analogue and digital participation formats, the following theory-informed propositions are used as analytical orientations.

Proposition 1: Employees' perceptions of influence and relevance within participatory formats are positively associated with acceptance and perceived WPI.
Proposition 2: The perceived participatory value of a format is shaped by the clarity of the process design and the extent to which employee input is meaningfully incorporated.
Proposition 3: Participatory formats structure interaction processes and thereby influence features such as immediacy, procedural structure, and vulnerability to interruptions.
Proposition 4: ATI constitutes a potential influencing factor in digital participation, although its relevance may be moderated by the usability and quality of facilitation of the digital setting.

Methodology

Sample and General Procedure

This study follows the Design Science Research (DSR) perspective, as it combines the identification of a practical organisational problem with the iterative development and evaluation of an artefact intended to address that problem. In DSR, researchers generate knowledge not only by observing organisational phenomena but also by designing and assessing artefacts in context (Hevner, 2007). In the present study, the paper-based dashboard prototypes constitute the artefacts, while the focus groups served to elicit user requirements and inform prototype development in a workplace innovation setting.

The data were obtained as part of an ongoing collaboration between TU Chemnitz and an SME located in a rural region of Saxony specialising in the development and production of technical nonwoven textiles. The company operates under a 24/7 shift system. To investigate the research question, both digital and analogue focus groups were conducted within the SME. The two participation formats were not implemented simultaneously. Rather, digital focus groups were conducted first with employees working at cutting machine one, followed by analogue focus groups with employees working at cutting machine two. The findings from

these sessions were subsequently used to develop two separate paper-based prototypes for the two cutting machines. The usability of the resulting paper-based dashboard prototypes was subsequently assessed using the System Usability Scale (SUS), a widely used instrument for evaluating perceived usability (Brooke, 1996; see also Grier et al., 2013). Figure 1 summarises the project phases in chronological order: requirements elicitation through focus groups, artefact design based on the qualitative analyses, and a later evaluation of both paper-based prototypes.

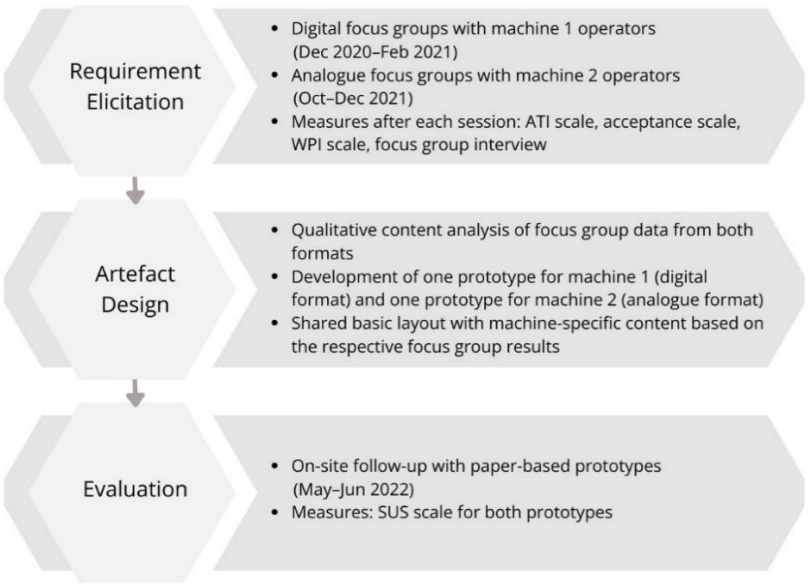

Figure 1: General procedure (source: own illustration)

Notes: ATI: Affinity for Technology Interaction scale (Franke et al., 2019); Acceptance Scale based on van der Laan et al. (1997); WPI scale: exploratory workplace innovation scale based on Kesselring et al. (2014); SUS: System Usability Scale (Brooke, 1996; see also Grier et al., 2013).

Procedure during Focus Group Meetings

In the digital focus groups (n = 16), employees operating the first cutting machine were interviewed, while the analogue focus groups (n = 14) comprised employees operating the second cutting machine. Because participation had to be organised around the shift system, the focus groups were conducted in several small sessions rather than as one joint meeting per condition. On average, about three employees participated per session. Each focus group session lasted approximately 20 minutes and took place shortly before or after the respective shift.

Initially, participants completed the ATI questionnaire (Franke et al., 2019). In the digital condition, the moderator joined via BigBlueButton, while the participants were physically present together in a conference room at the company and followed the interview via projected video and presentation. For the analogue groups, the same questions were presented on-site by an interviewer in person. This means that the distinction between digital and analogue refers to the mode of moderation and communication, not to a fully remote versus fully co-located participant setting.

The comparison of digital and analogue focus groups follows prior methodological work showing that internet-based and face-to-face focus groups may differ in interactional characteristics while still generating meaningful qualitative data (Nicholas et al., 2010). Participants were encouraged to share their thoughts and articulate their ideas aloud. Immediately after each focus group session, participants completed the acceptance scale (Van der Laan et al., 1997) and the exploratory WPI scale (Kesselring et al., 2014) to assess the respective participation format. Thus, the comparison between digital and analogue formats concerns post-session evaluations of acceptance and perceived WPI, whereas the qualitative interview content was used to inform prototype development separately for each machine.

The two formats were conducted in separate project phases and with different machine teams. However, because all participants worked in the same organisation, informal exchange between employees across machines outside the sessions cannot be ruled out. Demographic and job-related background variables beyond machine assignment were not systematically collected for analytical comparison and could therefore not be controlled for in the present study. The interview questions and the WPI scale, specifically developed for this study, are described below.

Focus Group Interview

To gather data on which information employees considered relevant for a revised machine display and how this information should be presented, participants took part in a guided focus group interview comprising five open-ended questions:
During which working step would looking at the display be of help?
Which working steps and information are absolutely necessary to be displayed?
Which critical working processes, associated with a higher potential for mistakes, should be emphasised?

How should the information be displayed?

How could a display assist you in maintaining focus and attention over the long term?
The purpose of the interview was not only to identify relevant display content, but also to collect ideas regarding ergonomic and supportive display design from the perspective of the machine operators. The interviews were transcribed and analysed using an inductive content-analytic procedure following Mayring and Fenzl (2019). Relevant interview passages were paraphrased, and semantically similar paraphrases were condensed into recurring content patterns, documented in analysis tables. These tables served as the basis for selecting the display elements for the respective paper-based prototypes by identifying which contents were mentioned most frequently across the focus groups. The qualitative analyses were conducted separately for the digital and analogue focus group data and informed the development of the respective machine-specific paper-based dashboard prototypes. Given

the exploratory and practice-oriented character of the study, no formal intercoder reliability coefficient was calculated.

Workplace Innovation Scale

To assess participants' perceptions of the WPI process, an exploratory scale was developed based on selected guiding questions proposed by Kesselring et al. (2014). Rather than measuring realised organisational WPI outcomes, the scale was designed to capture how participants perceived the quality, relevance, and anticipated impact of their participation in the focus group-based innovation process. Employees evaluated all items using a five-point Likert scale, with one indicating complete disagreement and five indicating complete agreement. The scale midpoint was three. Based on the data collected in this study, internal consistency was high (Cronbach's $\alpha = .89$). The instrument should therefore be understood as an exploratory measure of perceived WPI-related participation and expected effects rather than as a validated measure of actual WPI implementation success.

The first subscale addressed employees' perceived willingness and opportunity to participate in the WPI process. It was derived from the guiding question of whether employees and managers are willing and able to engage in workplace innovation (Kesselring et al., 2014, p. 4). The present study narrowed its focus to the employee perspective. The two items were:

- "Through the interview, I feel that I can bring my opinions and needs into decisions concerning the company."
- "Through participating in the interview, I feel part of a larger process."

The second subscale focused on the process dimension of WPI, based on the guiding question "How do employees and managers engage in fundamental and continuous processes enabling workplace innovation?" (Kesselring et al., 2014, p. 4). Again, the formulation was adapted to the employee perspective. The items were:

- "I would also like to be involved in other developments in the company to this extent."
- "Participation in such developments motivates me at work."

The third subscale addressed anticipated outcomes and impacts of the WPI process, based on the guiding question "What are the targeted outcomes and impacts of workplace innovation?" (Kesselring et al., 2014, p. 4). The items were:

- "Participating in the interview and its results will have a positive impact on my everyday work."
- "The participation and evaluation of such an interview will improve working in the company."

Taken together, the scale was used to compare digital and analogue focus group formats with regard to employees' perceived inclusion in the process, their willingness to participate in similar future developments, and their expectations regarding the potential benefits of the

WPI process. It should therefore not be interpreted as a direct measure of actual workplace innovation outcomes but as an exploratory measure of perceived participatory quality and anticipated impact.

Content validity of the exploratory WPI scale was supported through a theory-driven and practice-informed development process. The items were derived from key WPI dimensions described by Kesselring et al. (2014), especially employee participation, continuous engagement, and perceived outcomes, and were adapted to the specific organisational context of the participating SME. In addition, item wording and relevance were discussed within the project context to ensure their practical applicability to the focus group-based WPI process. Given the small sample and the exploratory character of the instrument, the scale is not presented as a fully validated measure but as a context-specific tool for assessing employees' perceptions of the participatory WPI process.

Results

Initially, the data gathered from the focus group meetings are presented. Subsequently, the process of developing paper-based prototypes derived from these focus group sessions is described. Finally, the results of the usability evaluation are reported and linked to the research question.

Focus Group Meetings

Because all relevant machine operators participated in one of the focus group meetings, descriptive statistics were used to compare the digital and analogue focus groups with regard to the scales deployed. Results are presented in Table 1. The descriptive statistics indicate no pronounced differences between the two formats with regard to ATI, acceptance, and perceived WPI.

	Digital focus group meetings				Analogue focus group meetings			
	M	*SD*	Skewness	Kurtosis	*M*	*SD*	Skewness	Kurtosis
ATI	3.935	0.561	0.346	-0.646	4.111	0.469	0.540	0.710
AM	0.976	0.589	0.442	-0.504	0.991	0.441	-0.642	-0.551
Satisfaction	1.036	0.562	0.314	-0.511	1.107	0.507	-0.493	-1.471
Usefulness	0.929	0.645	0.264	-0.373	0.862	0.427	-0.535	-0.393
WPI scale	3.726	0.601	0.476	0.482	3.548	0.416	0.280	-1.339

Table 1: Descriptive statistics of focus group meetings (source: own calculations)

Notes. M: Mean; SD: standard deviation; ATI: Affinity for technology interaction scale; AM: simple scale for acceptance measurement with subscales satisfaction and usefulness; WPI scale: workplace innovation scale

Comparing the scales across the digital and analogue focus groups, none of the means differed markedly. Across the ATI questionnaire, the acceptance scale and its subscales, and the WPI scale, mean differences were smaller than the respective standard deviations.
Accordingly, the descriptive patterns do not point to pronounced differences between the analogue and digital focus groups in their ratings of interview acceptance and perceived WPI, as represented by the three subscales referring to individual participation, process, and outcomes of WPI. These descriptive findings should not, however, be interpreted as evidence of equivalence between the two formats. Furthermore, employees did not differ markedly in their affinity for technology interaction at the descriptive level.

To examine whether ATI was associated with the interview ratings, a Kendall's tau correlations were calculated. Neither the correlations between ATI and the simple acceptance scale (r = .079) nor that between ATI and the WPI scale (r = -.059) were significant (p > .05) for the digital focus groups. Similarly, no significant correlation was found for the analogue focus groups (p > .05). Thus, the data do not indicate a systematic relationship between ATI and the evaluation of the focus group format.

For the digital focus groups, 90 paraphrases were collected. Recurring themes across the digital sessions concerned production progress, order identification, anticipation of the following order, and the need for concise and easily interpretable visualisations. Across all digital focus groups, participants agreed that displays should present essential order-related information in a concise and intuitive manner. This included the remaining duration of the current order, which one participant described as a useful feature already known from another production line: "Well, that's the remaining time, or something like that, … That wouldn't be bad here either." (Focus group one, digital, participant I3; translated by the author). The item or article number was also considered highly relevant, with one participant stating that it was "the most important thing" (Focus group two, digital, participant I2; translated by the author).

With regard to visualisation, participants favoured simple formats, for example a horizontal bar, which was seen as "actually the most obvious" way to display progress (Focus group two, digital, participant I1; translated by the author). In addition, participants stressed that information on the subsequent order should be visible, as "the follow-up order would still be important" (Focus group three, digital, participant I2; translated by the author).

For the analogue focus groups, 48 paraphrases were collected. Recurring themes concerned production progress, running time, and concise presentation of information. Across all analogue groups, participants consistently expressed the need for information on the progress of the current order, complemented by running time and a short and precise display format. Item number and product number were mentioned equally often, while many other suggestions appeared only once. For example, one participant proposed the use of a

percentage circle to indicate order progress: “Perhaps also the percentage circle, so that one knows how far the order has progressed“ (Focus group 2, analogue, participant I3; translated by the author).

Additionally, preferences on how information should be displayed were voiced in both formats. Target-actual comparisons and graphic indicators of progress were mentioned in both types of focus groups, suggesting overlap in core informational needs despite possible differences in interaction dynamics during sessions.

Design of Prototype Concepts

Prototype A (see Fig. 2) was developed based on insights gathered during the digital focus groups. Information was selected according to the 10 most frequently mentioned paraphrases. This approach was guided by employees' expressed desire for the display to remain easily comprehensible and not overly complex. Only suggestions that were mentioned in at least three groups were adopted, indicating their relevance to more than half of the digital sessions. The incorporated information included the remaining duration of the order, the number of completed requirements, article number, product number, follow-up order, cutting speed and width, base material, and the degree of contamination of the textile rolls.

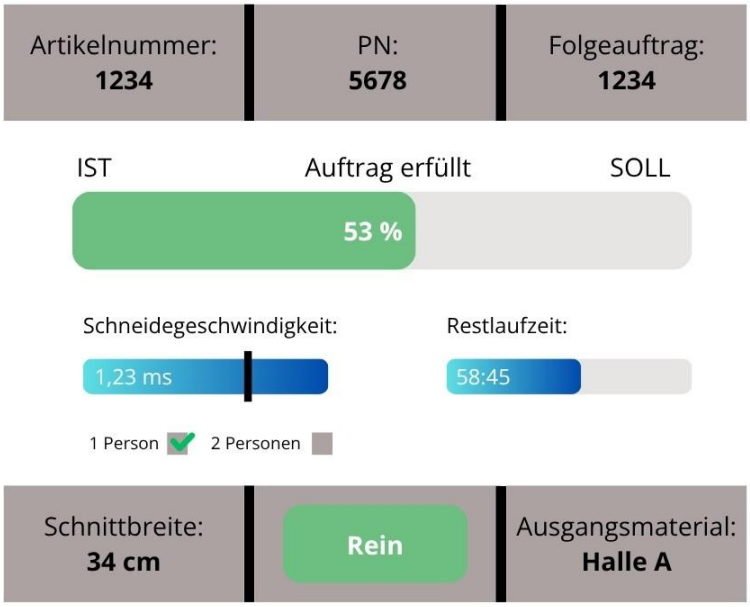

Figure 2: Prototype A based on digital focus groups (source: own illustration)

Notes: From left to right: the top row shows the article, product number, and follow-up order. The bottom row shows cutting width, cleanliness of material, and exit hall. The green bar shows order completion as a percentage. Below, cutting speed and remaining duration are shown.

Prototype B (see Fig. 3) was developed based on the analogue focus groups. Here, too, the most frequently mentioned information was prioritised and displayed prominently. Key metrics such as running metre, running time, article number, cutting width and cutting speed were emphasised. Because several items were mentioned with similar frequency, some

information was organised into lists, which increased the complexity of this prototype. The header included information on the previous, current, and subsequent orders. In addition, the prototype contained a target-actual comparison related to process progress and running metre, a percentage-based progress indicator, and sections with further information on material, joins, cutting width, packaging, number of rolls or pallets, customer information, intended use, and delivery date. Design preferences such as short and concise presentation, simplicity, large font, and usability were also considered.

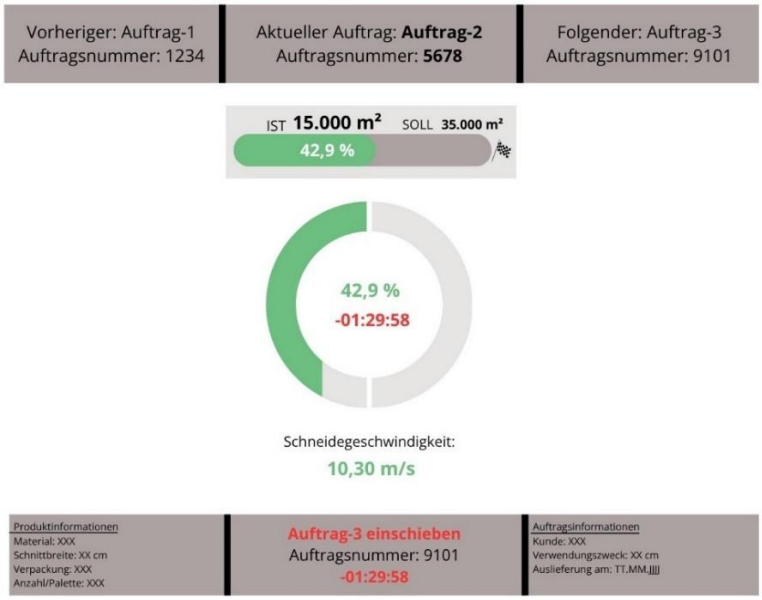

Figure 3: Prototype B based on analogue focus groups (source: own illustration)

Notes: From left to right: the top row shows the previous order along with its number, the current order and its number, and the next order with its corresponding number. The bottom row shows information about products, including material and packaging details, as well as orders that need to be slotted in, the remaining time, customer numbers, and delivery data. The green bar shows order completion as a percentage and in square metres. Below the percentage completion, remaining time and cutting speed are displayed.

Evaluation

Because the usability evaluation involved only a small and uneven subset of employees, descriptive statistics were used to evaluate the paper-based prototypes. The evaluation sample consisted of one participant from the digital focus group, nine participants from the analogue focus group, three employees who had not participated in either focus group, and two employees who could not recall whether they had participated in a focus group. The mean usability rating of Display A (M = 3.487, SD = 1.351) and Display B (M = 2.706, SD = 1.053) differed descriptively, with Display A receiving the higher average rating. This pattern should be interpreted cautiously and not as robust evidence that one prototype was better than the other, given the small and uneven evaluation sample. Using the converted SUS scores, Display A reached M = 87 (SD = 34) and Display B reached M = 68 (SD = 26). While these values suggest descriptively more favourable usability ratings for Display A, both prototypes received overall positive usability ratings, and no statistically robust difference between them can be concluded on this basis. Because implementation of the displays at the cutting machines was

not feasible within the project period, the evaluation remained limited to paper-based prototypes and should be interpreted as a usability assessment of prototype concepts rather than an assessment of dashboards in operational use.

Discussion

The aim of this study was to investigate whether both digital and analogue participatory methods could facilitate WPI. Using digital and analogue focus groups, we collected requirements and ideas for the creation of two paper-based dashboard prototypes. Acceptance and perceived WPI were assessed for both participatory formats, while the later usability evaluation concerned the paper-based prototype concepts rather than dashboards in operational use at the machines. Taken together, the findings suggest that, within this exploratory case, both participatory formats were associated with positive ratings of acceptance and perceived WPI. The descriptive patterns did not indicate pronounced differences between the digital and analogue focus groups with regard to acceptance and perceived WPI. Slightly higher ratings were observed for the digital focus groups on some measures, and the paper-based prototype (Display A) developed from the digital sessions also received a somewhat higher usability rating in the small evaluation subsample. However, given the small and context-specific sample, the descriptive nature of the analysis, and the limited evaluation data, these differences should not be interpreted as evidence of superiority or equivalence of one format over the other. In addition, ATI was not systematically associated with acceptance ratings or perceived WPI in either group. Overall, the findings suggest that the key issue in this case was less whether participation was digital or analogue than how it was organised, enabled, and embedded in the organisational context. This does not mean that format was irrelevant, but rather that any format effects appeared to depend on the broader participatory setting in which the process took place.

With regard to the theoretical propositions, the findings provide cautious support for *Proposition 1*, as both formats were associated with positive ratings of acceptance and perceived WPI, indicating that employees perceived the participatory process as relevant, experienced some degree of influence within it, and evaluated it positively. *Proposition 2* is also cautiously supported since the descriptive findings do not point to marked differences in participatory value between digital and analogue formats, suggesting that process design and the meaningful integration of employee input may be at least as important as the participation format itself. *Proposition 3* is tentatively reflected in the qualitative and contextual material, as the two formats appeared to differ in interaction conditions that may have influenced immediacy, procedural structure, and vulnerability to interruptions, although these aspects were not systematically measured. By contrast, *Proposition 4* received no clear empirical support in the present data, as ATI was not systematically associated with acceptance or perceived WPI in either group. Accordingly, the *research question* can be answered only in a cautious and exploratory manner: in this case study, both digital and analogue participatory approaches appeared capable of supporting WPI processes, but

similarities in perceived outcome ratings should not be taken to mean that the two formats are interchangeable in general.

More specifically, the present case suggests that participatory quality depended on how strongly employee input was integrated into the process and on whether the organisational setting enabled focused and meaningful participation. In the present study, these framing conditions included temporal aspects such as scheduling in relation to shift work, spatial conditions such as the physical setting of the sessions, social factors such as the presence of supervisors, and procedural factors such as the coordination and standardisation of the sessions. These conditions did not merely accompany participation but formed part of the participatory architecture through which WPI was enacted.

Limitations

The present study has certain limitations that must be acknowledged. This investigation is a case study based exclusively on descriptive statistics. Thus, the results are not directly generalisable to other organisations. Although all employees operating the cutting machines participated in the focus group meetings, the sample size remains too small and context-specific to draw broad conclusions regarding the equivalence of digital and analogue participatory formats for WPI. Nevertheless, the findings may serve as preliminary indicators and provide a basis for future research across diverse organisational settings.

The standardisation of the focus group interviews was limited, as digital and analogue sessions were facilitated by different moderators and conducted under varying conditions. The analogue interviews took place in a lunchroom environment characterised by higher noise levels, interruptions from non-participating co-workers, and uneven time conditions across participants. In contrast, the digital focus groups were conducted in a quieter setting with the presence of a shift manager, potentially fostering higher engagement. These contextual differences may have influenced employee motivation and could partly explain the higher number of paraphrases generated in the digital focus groups. More broadly, the comparison does not isolate the effect of participation format alone, because it was intertwined with machine context, facilitation, and situational conditions.

Furthermore, the evaluation was restricted to paper-based prototypes and was affected by considerable sample mortality. Only one participant from the digital focus group and nine from the analogue group took part in the evaluation; three additional employees had not participated in either focus group, and two could not recall whether they had participated. This limits the ability to draw conclusions about potential differences between the two formats. Although each focus group session lasted approximately 20 minutes in both formats, resource expenditure and process costs were not systematically assessed beyond session duration. Therefore, no conclusions can be drawn about possible efficiency or effort-related advantages of digital formats. Access to organisational key performance indicators, such as productivity changes or sickness absence, was also unavailable. Future research could

usefully complement participatory and usability-oriented measures with such organisational indicators where feasible, in order to capture WPI processes across multiple levels and over time.

An important conceptual limitation concerns the distinction between perceived WPI and actual organisational outcomes. The present findings primarily reflect employees' subjective perceptions of participation, process quality, and anticipated impacts, rather than objective measures of WPI. While perceived WPI represents a theoretically meaningful construct, particularly in participatory and employee-centred approaches, it does not necessarily translate into realised organisational outcomes.

More generally, the findings were likely shaped not only by participation format but also by contextual and organisational framing conditions, including the physical and social setting of participation, time pressure, managerial presence, and the degree of procedural standardisation. Although these factors were not systematically controlled, they shape the participatory environment in which WPI processes unfold and may affect both the quality and quantity of employee contributions.

Theoretical implications

The findings of this exploratory study contribute to the WPI literature by lending cautious support to the proposition that participatory process quality may be more consequential for perceived WPI-related participation quality and anticipated impact than the participation format alone. Across both digital and analogue settings, employees reported positive levels of acceptance and perceived WPI, which points to the relevance of meaningful participation, perceived influence, and organisational embedding in participatory WPI processes. More specifically, the findings suggest that the mode of participation should be analytically distinguished from the quality of participation. While the descriptive results did not indicate pronounced differences in perceived participatory value between the digital and analogue formats, the study also points to possible differences in interaction dynamics. This indicates that digital and analogue participation may differ less in their basic capacity to enable participation than in the specific interaction conditions through which participation is enacted.

From a theoretical perspective, the evidence supports a process-oriented understanding of WPI. Rather than conceptualising WPI as dependent on specific tools or participation formats, the present case suggests that enabling conditions such as transparent process structures, meaningful integration of employee input into decision-making, opportunities for genuine participation, and organisational support may be more central explanatory mechanisms. In this regard, the findings resonate with the OWPI perspective adopted in this study, which emphasises the interdependence of human, organisational, and technological dimensions. At the same time, the study does not suggest that digital and analogue participatory approaches are equivalent, nor that format is irrelevant. Instead, it indicates that possible format effects

may be mediated by the broader participatory architecture and the organisational conditions under which participation takes place. Future theoretical research may gain from a clear differentiation between the mode and the quality of participation, as well as from a more systematic investigation into how various participatory environments influence interaction dynamics, inclusion, and innovation-related outcomes within organisational contexts.

Practical implications

The present case study's exploratory and non-generalisable character necessitates caution in drawing practical implications. For the focal SME, the findings suggest that digital participatory formats can represent a feasible way of conducting WPI processes under certain organisational conditions. In this case, the digital format appeared capable of eliciting relevant employee input and of supporting the co-creation of a dashboard concept in a manner that was acceptable to participants. At the same time, the study does not indicate that digital formats should replace analogue participation in general, nor that the choice of format can be treated as inconsequential. Rather, the findings point to the importance of selecting and designing participatory formats in accordance with the specific organisational context, including operational constraints, available infrastructure, interaction conditions, and the need for meaningful employee involvement.

For practice, this means that the successful use of participatory formats in WPI depends not only on choosing between digital and analogue settings but also on carefully shaping the conditions of participation. SMEs should therefore pay attention to factors such as appropriate scheduling, a low-distraction environment, clear moderation, reliable coordination, and the meaningful integration of employee contributions into subsequent design decisions. In addition, the presence of managerial actors during participation processes should be considered carefully, as it may either support or inhibit employee contributions depending on the situation. Particularly under conditions of limited resources, the design of participation should aim to make employee involvement both feasible and substantively effective.

For SMEs in particular, this implies that digital participation may be a useful option where face-to-face participation is difficult to organise, but its effectiveness is likely to depend on careful facilitation and meaningful integration of employee contributions. Future studies should consider evaluating prototypes after technical implementation at the workplace, in addition to paper-based prototype assessments, and should also incorporate process-related effort and resource requirements where possible. If future research confirms these patterns across broader contexts, digital participation may in some settings prove advantageous not only in terms of flexibility but also in terms of organising participatory processes under limited organisational resources (Miebach, 2020).

Conclusion

This article examined the use of digital and analogue focus groups to support a WPI-oriented participatory process in a German SME. Perceived WPI was assessed using a questionnaire inspired by the WPI layers as defined by Kesselring et al. (2014). The findings suggest that both digital and analogue participatory formats were capable of supporting the participatory WPI process in the studied case. Descriptively, no pronounced differences were observed in acceptance or perceived WPI, although slightly more positive ratings were found for the digital format on some measures. However, these patterns should be interpreted with caution, given the single-case design, the small and context-specific sample, the descriptive nature of the analysis, and the limited evaluation data. Rather than indicating that digital and analogue participation are equivalent, the findings suggest that how participation was organised, enabled, and embedded in the organisational context was more consequential than format alone. In particular, the case suggests that the quality of participation depends not only on the format itself but also on framing conditions such as scheduling, the physical setting, interruptions, managerial presence, and procedural coordination. In this sense, the case study contributes to WPI research by suggesting that the quality and organisational embedding of participation may be at least as important as the participation format itself, without implying that digital and analogue formats are interchangeable. At the same time, the case indicates that digital and analogue formats may differ in their interaction dynamics and implementation conditions, which may affect the overall effectiveness of participation in WPI processes. Further research with larger samples, more standardised comparison conditions, and longitudinal data following technical implementation of the prototypes is needed to assess more systematically how different participatory formats influence WPI processes and outcomes across organisational contexts.

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Reframing Success in Embodied Work

Competing Perspectives on Occupational Exoskeleton Adoption

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Abstract

Technology adoption is often framed in binary terms of acceptance or resistance, oversimplifying the complex dynamics of workplace integration. This study introduces the Normalisation-Situated Practice Matrix (NSPM), an analytical heuristic that maps the degree of organisational embedding (normalisation) against the degree of experiential user engagement (situated practice), providing a new way to understand how different stakeholders negotiate the deployment of new technologies. Focusing on occupational exoskeletons in a warehouse setting and drawing on observational fieldwork and 34 semi-structured interviews with frontline employees, managers, and technical and academic experts, this study explores the competing goals, approaches, and lived experiences of these diverse groups.

Our thematic analysis identifies three key dynamics: (1) a disconnect between managerial decisions and employee work realities, pointing to the challenges of top-down implementation; (2) the active role of employees in adapting technology through informal, practice-based strategies that operate alongside official guidelines; and (3) the existence of competing narratives around exoskeleton use that reflect broader organisational tensions, where decision-making authority is concentrated at the executive level while frontline workers bear the embodied consequences. Rather than defining success solely through implementation efficiency or binary adoption metrics, our study demonstrates that technology adoption is a dynamic and contested process shaped by power relations, situated practices, and multiple stakeholder perspectives. The NSPM structures examination of these complexities and reframes success in human-centric terms, offering a diagnostic tool applicable across diverse technology integration contexts.

Keywords: narratives of success, occupational exoskeletons, organisational dynamics, participatory processes, workplace technology adoption

Introduction

The increasing adoption of digital and automated technologies is reshaping workplace environments across industries (Sanyal & Kumar, 2025; Oeij et al., 2019). This study starts from the premise that to successfully integrate embodied, physical workplace technologies like occupational exoskeletons, we need a broader, human-centric perspective that aligns organisational goals with lived, situated experiences. While technological innovations promise reduced workload (Galiano et al., 2024), safer working environments (Ghobakhloo et al., 2023), and more efficient operations (Santa et al., 2013), integrating new technologies into complex, real-world settings is rarely straightforward. As organisations increasingly rely on emerging technologies to drive productivity, safety, and competitive advantage (Leesakul et al., 2022), success cannot be defined solely by functionality or performance metrics but by how technologies are interpreted and negotiated by stakeholders.

Existing research tends to prioritise managerial viewpoints, emphasising efficiency gains and safety measures (Lamberti et al., 2017; Jiao & Zhao, 2014). Additionally, emerging technologies are frequently evaluated using approaches that categorise technology adoption outcomes as acceptance or rejection (Molino et al., 2021; Bhattacherjee & Hikmet, 2007; Donmez-Turan, 2019). While providing high-level insights, this narrowed focus and binary lens overlook the nuanced, everyday interactions between users and technology. Recent studies indicate that successful technology adoption requires managing interactions among various stakeholders and creating environments that foster trust and employee participation (Oeij et al., 2021) and depends not only on technical performance but also on the interplay between employee engagement and organisational culture (Oeij et al., 2022), particularly in industries like logistics, where new technologies directly reshape physical work practices.

Building on this understanding, this study draws upon key concepts from science and technology studies (STS), organisational communication, and the sociology of work, specifically the concepts of normalisation and situated practice. *Normalisation* refers to how tools become embedded and taken for granted within everyday routines (May & Finch, 2009; Murray et al., 2010), while *situated practices* highlight how technologies are adapted, resisted, or reinterpreted in specific organisational contexts (Lave & Wenger, 1991). Existing frameworks tend to address these dimensions separately: Normalisation Process Theory (NPT) provides an account of institutional embedding mechanisms (May & Finch, 2009), but underspecifies how users adapt technologies in practice. Meanwhile, practice-based approaches foreground user agency and contextual adaptation (Suchman, 1987) but often lack systematic attention to the organisational structures within which practices unfold. By combining these perspectives through a proposed Normalisation-Situated Practice Matrix, this study makes misalignment between these dimensions analytically visible: it enables the identification of cases where formal organisational embedding and experiential user engagement diverge. This capacity to diagnose non-alignment is the matrix's distinctive contribution. It reveals, for instance, how high formal integration can coexist with low experiential adaptation or how strong situated engagement can emerge despite limited organisational support. The matrix is designed to: (1) identify the alignment between user

engagement and organisational embedding, (2) diagnose adoption challenges in context, and (3) support adaptive, human-centred integration strategies.

Occupational exoskeletons serve as an ideal case for exploring these dynamics. Designed to reduce physical strain and improve employee well-being, these wearable devices are uniquely positioned to reveal the tensions and complexities of technology integration by intersecting productivity goals with employees' bodily experiences (Bogue, 2018; De Looze et al., 2016). Unlike software or digital tools, exoskeletons directly reshape physical routines and embodied work, making the processes of user adaptation, resistance, and creative appropriation particularly visible. Their success depends on how well the technology is fitted to the real conditions of use, and moreover, is highly dependent on employees' willingness, capacity, and active participation in integrating devices into their daily physical routines.

To address these gaps, this study reframes successful occupational exoskeleton adoption as a situated, iterative process, examining how normalisation and situated practice shape technology integration. The following research question guides the inquiry: *How do normalisation processes and situated practices interact across stakeholder groups to shape the adoption of occupational exoskeletons in warehouse settings?* The research reveals how alignment between organisational perspectives, material conditions, and user adaptations determines what constitutes meaningful integration success, challenging approaches that prioritise formal processes over emergent practice.

To facilitate technology integration in the workplace, we propose the *Normalisation-Situated Practice Matrix* as an analytical heuristic that captures both organisational support and users' situated, adaptive practices. The matrix is neither a universal theory of adoption nor merely a coding scheme; it structures empirical inquiry into the relationship between formal embedding and experiential engagement within specific organisational contexts. The matrix highlights that (1) frontline employees actively co-construct technology use; (2) success is context-dependent and shaped by lived, embodied practice; and (3) technology integration involves ongoing negotiation rather than linear rollout. These findings challenge traditional success metrics, such as adoption rates or user satisfaction scores, and contribute to the development of more inclusive integration strategies that recognise employees as active participants in, rather than passive recipients of, organisational decisions. By expanding existing technology adoption understandings to incorporate relational, experiential, and contested dimensions through a human-centric approach, the matrix can help promote inclusive design and policy decisions (Pasmore et al., 2019). This suggests that, rather than applying universal implementation strategies, technology adoption regulations should allow for gradual familiarisation processes and employee autonomy in adaptation strategies.

Overall, our study makes three interconnected contributions to workplace innovation literature. Conceptually, it combines normalisation theory and situated practice perspectives to create an integrated analytical approach that reveals the relationships and discrepancies between formal embedding and experiential engagement. Empirically, it provides an in-depth

examination of embodied technology adoption through the case of occupational exoskeletons in warehouse settings. Methodologically, it demonstrates how the Normalisation-Situated Practice Matrix can serve as both a diagnostic and strategic tool applicable to different stakeholder perspectives. Rather than prescribing specific implementation protocols, this article offers a flexible analytical model for analysing context-specific adoption dynamics and identifies key leverage points for human-centric integration strategies.

Theoretical framework

Normalisation and situated practice

Science and Technology Studies (STS) has long challenged techno-deterministic adoption narratives. The integration of emerging technologies into organisational life is neither a straightforward technical implementation nor a simple function of managerial will; it is a socially embedded process shaped by institutional logics and the lived realities of users (Suchman, 1987; Orlikowski, 2007).

To develop a context-sensitive understanding of technological integration, we focus on two complementary concepts: normalisation and situated practice. Each offers critical insights into the integration process; however, focusing on one exclusively risks either overstating the coherence of organisational adoption or underestimating the structural conditions that shape individual engagement. These concepts are synthesised here in our Normalisation-Situated Practice Matrix, a tool for mapping the divergences between policy and practice, system and experience, and intended and emergent outcomes.

Normalisation: Embedding technology in organisational practice

Normalisation provides an understanding of how new technologies become embedded in routine practice. At its core, normalisation refers to the institutional embedding of a technology into organisational rhythms, policies, expectations, and discourses (Carroll & Conboy, 2020; Sooklal et al., 2011). It marks the point where a tool transitions from novel or disruptive to a component of everyday work infrastructure – so integrated that its presence may no longer be consciously acknowledged by users (Bax, 2011). This involves a deep alignment between the technology's functions and organisational norms, whereby managerial discourse and power structures frame its use as 'common sense' (Flichy, 1998).

Within the STS tradition, normalisation is understood as a cumulative process occurring through social practice. Technologies do not arrive pre-formed or stable; rather, they are co-constructed through ongoing negotiations across time, space, and actor networks (Hyysalo et al., 2019), challenging linear adoption models and calling for longitudinal analyses that consider the diversity of implementation contexts.

NPT, developed by May et al. (2009), outlines four key mechanisms of embedding: coherence (sense-making), cognitive participation (engagement), collective action (operationalisation), and reflexive monitoring (evaluation). These mechanisms explain how individuals and groups come to understand, commit to, and sustain technological practices. Yet normalisation is rarely straightforward, as it involves ongoing work in which actors negotiate meaning, reconfigure responsibilities, and redefine routines to embed a technology in everyday work (Melby & Hellesø, 2014).

Critically, normalisation is not merely an outcome but a strategic and discursive process, shaped by managerial narratives that define "successful" implementation. Over time, these discourses can obscure earlier frictions or resistances by institutionalising specific framings of the technology's value. Flichy (1998, p. 109) conceptualises normalisation as creating a "boundary-object", a sociotechnical construct that enables coherence across different communities of practice, facilitating a technology's stabilisation and making it amenable to scaling.

Situated practices: Contingent use of technology

Situated practices refer to the locally enacted, often informal, and improvised activities through which individuals engage with technology in specific settings (Neufeld & Delcore, 2018). These practices reveal the dynamic interplay between institutional structures and user agency, exposing how technologies are reconfigured and reinterpreted "from below" through context-dependent interactions shaped by local knowledge and informal adaptations (Turner, 2011; Sun, 2012).

Socio-material perspectives reveal how technologies are continually reconfigured through embodied interaction. As Suchman (1987) argues, action is shaped by emergent conditions rather than following predefined plans. Users actively interpret and negotiate technologies through situated practice (Orlikowski, 2000; Nicolini, 2012), modifying tools, working around constraints, or appropriating functionalities for unintended purposes. These micro-level adjustments are central to a technology's success or failure, recasting employees as active co-constructors. For example, Skjølsvold et al. (2015) show that systems like smart grids function as 'situated technologies', shaped by local socio-material contexts. Meanwhile Sackey et al. (2015) demonstrate how Building Information Modelling (BIM) implementation is closely tied to organisational culture and existing practices, highlighting the analytic value of situated practices in explaining the variability of technology integration.

Human-centric approaches further emphasise the emotional and cultural dimensions of engagement. As Cavelty (2018) argues, technological systems are inseparable from users' beliefs and values. Müller and Kenney (2014, p. 537) capture "situated moments of reflection, connection, and disruption", showing how individuals may contest or reframe dominant technological narratives. From a practice-based perspective, technologies are co-constituted with the environmental rhythms, bodies, and discourses within which they operate (Suchman,

2006). Recognising technology's social and political situatedness enables more democratic and inclusive approaches to design and governance (Ribeiro et al., 2018; Latimer & Gómez, 2019).

The Normalisation-Situated Practice Matrix

By combining the concepts of normalisation and situated practice, we can bridge macro-level institutional logic with micro-level user experience, aligning with socio-material theories that emphasise the mutual constitution of actors and artefacts (Orlikowski, 2007; Leonardi, 2011; Scott & Orlikowski, 2025). This reorients attention from technologies as 'finished' innovations toward processes integrating initial scientific development phases with practical application (Lyle, 2021, p. 411).

The Normalisation-Situated Practice Matrix's contribution is best understood in terms of the analytical visibility it provides that adjacent frameworks cannot. NPT operates along a single evaluative dimension, the degree of normalisation, treating successful institutional embedding as its primary analytical endpoint. In doing so, it lacks the conceptual grounding to account for configurations in which high normalisation coexists with low experiential engagement, the condition we term Formal Compliance. Within an NPT framework, such configurations produce no analytical signal: the coexistence of deep institutional embedding and limited user engagement cannot be registered as a theoretically significant or potentially enduring outcome. Our matrix addresses this limitation directly by introducing situated practice engagement as a second, independent dimension, making this disjunction a legible and actionable analytical category. Practice-based and socio-material frameworks foreground the contingent, locally enacted dimensions of technology use, but typically lack systematic mechanisms for locating situated practices relative to organisational structures. The matrix provides this relational mapping. It differentiates whether situated engagement occurs with institutional support (Embedded Routine) or without it (Local Experimentation), a distinction carrying substantially different implications for sustainability and scalability. While prior scholarship has applied NPT to enterprise technology contexts to examine how technology-driven work practices become embedded and routinised (Carroll & Conboy, 2020), such work has generally remained within NPT's own analytical boundaries rather than treating (non-)alignment between institutional embedding and user engagement as a distinct analytical concern. This is the matrix's core contribution: not the prediction of adoption trajectories but the systematic surfacing of the configurations and tensions that shape them, making visible the use states that matter most for material interventions and for understanding the fundamentally human and relational dimensions of technological change.

The x-axis represents the Level of Normalisation: the extent to which a technology is formally embedded into organisational routines, structures, and policies (Carroll & Conboy, 2020) (Figure 1). The y-axis represents the Level of Situated Practice engagement: the extent to which employees use the technology in embodied, adaptive, and meaningful ways (Berner, 2008) (Figure 1). Each axis is a continuum from low to high, enabling categorisation into four

quadrants that allow for informed interpretation of how formal systems and lived practices align or diverge. This reframes success as a relational and negotiated outcome.

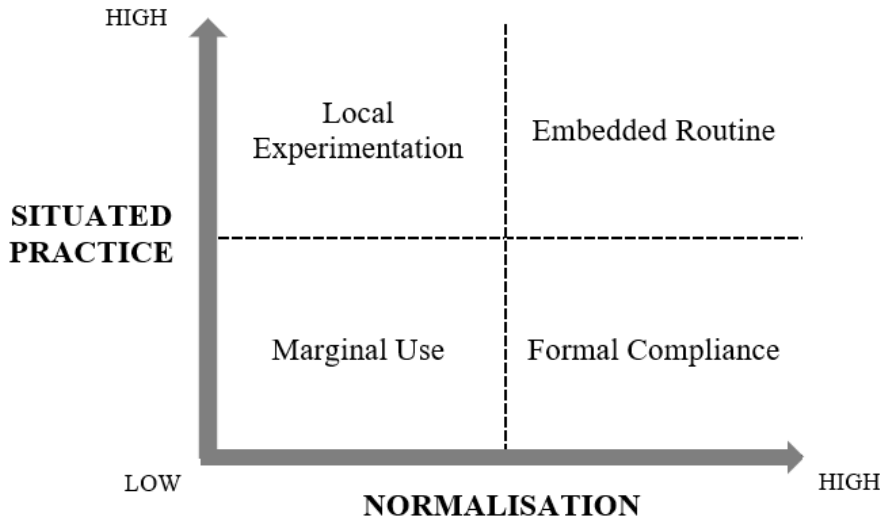

Figure 1. Normalisation-Situated Practice Matrix

The four quadrants of technology integration

The four quadrants represent distinct configurations of technological integration, offering analytical lenses for how formal organisational embedding and experiential user engagement intersect.

Low Normalisation–Low Situated Practice: Marginal Use

This quadrant characterises contexts where technology fails to integrate meaningfully into work practices due to both limited institutional embedding and user disengagement. Technologies in this quadrant remain peripheral, viewed as irrelevant rather than essential to task performance (Bax, 2011). The absence of cognitive participation and formal institutional support results in widespread disengagement (Hall et al., 2017), while inadequate operational design fails to incorporate novel tools effectively. When technologies are imposed without considering contexts, users struggle to develop structured or embodied practices, obscuring the interdependencies between social and technical factors (Crabtree et al., 2024; Macpherson & Clark, 2009). Without communities of practice to foster collective learning, shared understandings of effective technology use cannot develop (Wenger, 1998; Hsiao et al., 2003).

High Normalisation–Low Situated Practice: Formal Compliance

In this quadrant, technology implementation is driven by top-down mandates with minimal local adaptation and limited workforce engagement (Powell & Colin, 2009). Technology use is normalised at the policy level but remains superficial, employed to fulfil compliance requirements rather than enhance operational effectiveness. Adherence to usage protocols irrespective of workflow alignment fosters a dynamic of procedural compliance, where strict managerial enforcement often overlooks productivity trade-offs and where employees find it

challenging to use mandated tools effectively without feeling a sense of ownership or meaningful interaction (Hall et al., 2017). Training focuses on operational functionality while neglecting reflective practice development, creating a disconnect between formal instruction and the actual experience (Halperin, 2017). When tools are decoupled from the social contexts of work, they become rigid artefacts rather than enablers of meaningful practice (Kendall et al., 2020), resulting in limited knowledge transfer as users struggle to perceive the tools' relevance (Pine & Mazmanian, 2017).

Low Normalisation–High Situated Practice: Local Experimentation

This quadrant reflects adaptive employee behaviours operating with minimal institutional support. At initial technology deployment stages, situated interventions reveal how technologies and practices are co-shaped in context, turning uncertainty and friction into learning and innovation (Zuiderent-Jerak, 2015). Employees demonstrate high agency, using experiential knowledge and peer collaboration to develop effective, context-sensitive solutions outside formalised procedures. This capability is supported by creative self-efficacy, a psychological readiness that enables employees to innovate in the absence of institutional scaffolding (Puente-Díaz, 2016). Informal networks facilitate the exchange of insights and the collective construction of localised strategies, fostering collaboration and co-constructing tacit knowledge bases that may remain invisible to institutional mechanisms (Hara, 2009; Frisk & Middelkoop, 2023). This dynamic space of engagement, where creativity, improvisation, and collective intelligence thrive despite low institutional normalisation, reveals how employees creatively respond to systemic gaps and repurpose technologies to address immediate functional demands (Latimer & Gómez, 2019).

High Normalisation–High Situated Practice: Embedded Routine

This quadrant represents the configuration where technologies are meaningfully embedded through mutual reinforcement between formal structures and informal, embodied practices. From a socio-material perspective, this quadrant reflects technology and work co-constitution, where technologies are enacted through and within social practices rather than serving as merely instrumental tools (Cecez-Kecmanovic et al., 2014). Formal structures meet technological normalisation preconditions, while frontline routines adapt these structures to the dynamic realities of everyday work (Crompton, 2019; Pine & Mazmanian, 2017). Dynamic adaptation capacity proves vital during disruption, as effective organisational responses depend on seamless transitions between formalised protocols and improvisational problem-solving (Poutanen et al., 2016). Reflexive monitoring enables continuous evaluation (May et al., 2009). Distributed agency ensures technology evolution is informed by both formal decision-makers and frontline workers (Leonardi, 2011), and institutional memory captures lessons learned (Labatut et al., 2012). These mechanisms create self-reinforcing cycles in which organisational practices develop momentum that recursively reproduces and strengthens particular patterns of action (Kremser & Sydow, 2022).

Technology background: Occupational exoskeletons

Occupational exoskeletons are wearable assistive devices designed to support employees in physically demanding environments, addressing significant concerns around musculoskeletal disorders, fatigue, and productivity (Theurel & Desbrosses, 2019). Research indicates that their adoption can decrease physical workload and alleviate strain (Crea et al., 2021; Kermavnar et al., 2021), yet user experiences vary significantly. Some employees report enhanced comfort and reduced fatigue, while others experience discomfort, emphasising the importance of individual differences in design and implementation (Botti & Melloni, 2023).

Successful exoskeleton implementation requires empirical, in situ validation that assesses effectiveness within specific workplace environments (Crea et al., 2021; Botti & Melloni, 2023). Social factors also matter: Elprama et al. (2020) demonstrated that perceived ease of use and social influence are key predictors of industrial workers' intention to use exoskeletons, while Shore et al. (2018) argue that directly involving users as co-designers is crucial to maximising acceptance and reducing stigma associated with assistive devices. The interaction between exoskeletons and individuals' self-efficacy plays a pivotal role; tangible reductions in physical strain often encourage further engagement (Siedl & Mara, 2021; Siedl et al., 2024). Andrade and Nathan-Roberts (2022) emphasised that one-size-fits-all approaches are ineffective and that exoskeletons must be tailored to specific job requirements and user needs, a conclusion echoed by Crea et al. (2021) calling for systematic field validation across different real-world settings.

Methods

This study was conducted as part of a wider interdisciplinary project developing human-centric approaches to technology integration for workforce empowerment.

Research design and context

This qualitative case study employs thematic analysis to examine how different stakeholders interpret and challenge the practical application of exoskeletons. The study investigates the implementation of the Auxivo LiftSuit 2.0 occupational exoskeleton within a warehouse organised around Picked-by-Line (PBL) and Temperature Controlled (TC) operational models, examining how its adoption is shaped by stakeholder-ascribed meanings and daily work practices. The focus on this industrial logistics context stems from the broader tension between technological innovation and real-world implementation; in the logistics sector, exoskeletons are often introduced in response to high rates of musculoskeletal stress, workforce shortages, and productivity demands (Crea et al., 2021; Schrøder Jakobsen, 2024).

Participants and data collection

Empirical data was gathered through semi-structured interviews and direct participant observation. A total of 34 interviews were conducted with a diverse range of participants, including frontline warehouse employees, managerial staff, technical developers, and academic experts (Table 1). Participants were recruited through a purposive sampling strategy, using criterion-based selection to recruit participants with relevant experience of exoskeleton use. Employees with operational exoskeleton experience were selected via managerial gatekeepers, while managers and experts were recruited based on their direct involvement and domain expertise. This recruitment strategy ensured representation across three key stakeholder groups: (1) direct users (warehouse operators, n=12), selected to capture variation in experience levels and exoskeleton usage patterns; (2) organisational decision-makers (operational managers, n=7) representing different functional areas; and (3) technical and academic experts (n=15) including ergonomists, researchers, professors, and developers with specialised knowledge of exoskeleton technology and human-centred design. This distribution was designed to triangulate perspectives and capture a wide spectrum of implementation experiences, from frontline embodied practice to strategic decision-making and technical expertise. Ethics approval for the study was obtained from the relevant ethics review board prior to the start of the research, and informed consent was granted by participants.

Exoskeleton case study participants	
Operators	12
Operational managers	7
Ergonomists	2
Researchers (HC technologies, UX design, robopsychology)	5
Professors (ergonomics, human factors, operations and innovation management, biorobotics)	4
Technical developers and project leads	4
Total	**34**

Table 1. Interviews with participants across the exoskeleton case study

Observational data was collected during a week-long site visit to a large European warehouse facility. The observations focused on exoskeleton usage patterns, workplace interactions and the physical environment. Field notes documented body movements, device adjustments, peer interactions, informal problem-solving and discrepancies between prescribed and actual usage. A participant-observer approach was adopted, involving informal conversations with operators during breaks. These observations complemented interview data, revealing tacit practices and non-verbal aspects of technology adoption that participants might not have articulated in interviews.

Data analysis

The analysis examined technological adoption at the intersection of organisational structures and everyday practices using Atlas.ti software. The analytical process was conducted through four iterative phases. In the first phase, all interviews were transcribed, pseudonymised, and subjected to initial inductive coding. This helped ensure interpretive consistency and enabled ongoing dialogue about emergent themes. Through this inductive process, initial empirical patterns suggested a two-dimensional space defined by the degree of organisational embedding and the degree of experiential user engagement; the core structure of the matrix thus emerged inductively from the data before being theoretically refined. In the second phase, codes were organised into thematic clusters through constant comparison, enabling identification of patterns of convergence and divergence across stakeholder groups. Codes were iteratively refined through successive passes over the data with authors comparing, splitting, and merging codes to improve analytical precision and ensure internal coherence within each thematic cluster. In the third phase, a theoretically informed stage drew on normalisation and situated practice literature to develop higher-order categories. Thematic codes were re-examined in the context of the matrix's core quadrants, with codes mapped to axes and quadrant-specific patterns identified. This phase also involved mapping the inductively derived two-dimensional structure onto the theoretical concepts of normalisation and situated practice, resulting in the final model. In the fourth phase, analytical validity was confirmed through triangulation across multiple data sources and stakeholder perspectives, ensuring that thematic patterns reflected convergent evidence. While the sample captured substantial thematic recurrence across stakeholder groups, we do not make formal claims of theoretical saturation. Instead, we observed that the final stages of coding produced fewer new themes, and that triangulating the analysis with interviews, observations, and expert perspectives increased its robustness.

Exoskeleton implementation through the Normalisation-Situated Practice Matrix

Four unique patterns of technology integration were identified through thematic analysis of observational and interview data, corresponding to the quadrants of the Normalisation-Situated Practice Matrix. These patterns are not mutually exclusive categories; rather, they represent the dominant and sometimes overlapping dynamics that emerged as stakeholders negotiated the use of exoskeletons in their daily work.

Marginal Use: Limitations override formal support and user engagement

Despite widespread implementation processes across industries, exoskeletons frequently remain at the margins of workplace practice due to fundamental technical limitations that manifest as both physical and psychological disengagement. This exemplifies how employees can experience technology as burdensome rather than beneficial when there is inadequate alignment between technology design and deployment environment demands (Wong et al., 2023).

Movement restriction represents the most significant technological limitation, with experts noting "inflexible rigid elements" that disrupt natural movements (Sophie, expert). Order-picker employees face particular challenges, as they must walk with the device approximately 80% of their shift (Percy, expert), and the devices also "limit lateral movement" and interfere with other equipment (Noah, operator). These restrictions disrupt established movement patterns (James, operator), with one employee comparing the experience to confinement (Leo, operator). These observations demonstrate how users can perceive technology as counterproductive (Pine & Mazmanian, 2017).

Beyond physical constraints, invisible frictions significantly undermine integration. Employees understood the exoskeleton's preventive purpose but expressed scepticism. Some operators felt exoskeletons were introduced too late to address existing injuries (Lucas, operator), and others lacked motivation due to dissatisfaction with the device (Benjamin, operator). Such doubts contribute to ongoing debates about whether operators should wear devices without clear evidence of benefits (Kenneth, expert), especially as infrastructure limitations compound concerns (Lilian, expert). User agency compounds these issues, with experts noting that unwilling users will avoid device use (Percy, expert), sometimes with complaints of persistent pain (Emily, operator; Benjamin, operator; Leo, operator). Tacit resistance typically results in quiet abandonment, as users revert to established practices when confronted with inadequately integrated systems (Lyle, 2021). Physical discomfort from heat and weight creates additional barriers. Warehouse temperatures frequently exceed 25°C, causing "terminal discomfort" from excessive sweating (Julian, expert), with many employees identifying thermal issues as their primary concern (Ethan, operator; Liam, operator; Jack, operator).

Formal Compliance: Top-down implementation without user engagement

In top-down implementation, organisational processes dominate over user experience. This is characteristic of environments where new ideas and technologies signal a commitment to innovation rather than meaningful improvements to everyday work practices (Bednar & Welch, 2020). Strategic choices are made by management with minimal employee input (Lilian, expert; Kimberly, expert), and technology is followed as a directive rather than meaningfully integrated. This dynamic reflects broader patterns of organisational power asymmetry (Clegg et al., 2006), where authority to mandate adoption concentrates at executive levels while frontline workers bear the embodied consequences. However, our findings reveal that power relations are not unidirectional; employees exercise agency through tacit resistance and informal adaptation strategies.

Expert consensus strongly favours voluntary approaches, highlighting that the "main difficulty is when management says it's obligatory" (Kenneth, expert) because mandatory use leads to immediate dislike (Philip, expert). This aligns with employees' preferences for voluntary use and individual choice (Noah, operator; Ethan, operator; Leo, operator). Managerial views remain divided: while some advocate for mandatory use to ensure consistent adoption and

reduce strain-related injuries (Daniel, manager), others question the health implications of requiring use without consent (Emma, manager).

Risks of improper implementation are evident when workers wear devices incorrectly and experience disappointment (Sophie, expert), reinforcing the necessity of ongoing technical assistance. Employees highlighted positive training experiences (Olivia, operator), emphasising field-based instruction that reflects task realities, including necessary device adjustments (Henry, operator). Comprehensive support systems require a central contact point for monitoring concerns (Violet, expert; Kimberly, expert; Julian, expert) and ensuring device proximity (Caroline, expert).

Reduced productivity concerns represent a major barrier for operators (Lilian, expert; Julian, expert): "My difficulty was that I like to produce quickly, and I realised that with the exoskeleton I cannot do that much. […] I am worried about my production getting lower" (Olivia, operator). This tension creates ongoing stress, particularly among employees with performance-based pay structures, though some managers alleviate this concern by informing employees that pay would not be affected (Owen, manager).

Local Experimentation: Employee-driven adaptation and learning

Local experimentation emerges when employees actively engage with exoskeleton technology despite limited formal support. Adaptations emerge organically through necessity and contextual understanding rather than top-down directives (Murray et al., 2010; Wong et al., 2023).

Design flexibility proves crucial, with employees consistently advocating for customisation and choice, such as a "catalogue of exoskeleton models" allowing selection based on personal needs (Sophie, expert). This involves explicit advocacy for testing and choosing from different models (Noah, operator; Lucas, operator; Leo, operator; Benjamin, operator), reflecting needs for autonomy and control over workplace technology. Experts recognise time lags between initial device reception and full adaptation (Philip, expert), highlighting the value of experiential learning. The significance of user control over implementation timing and duration is also recognised, alongside advocacy for participatory strategies that give employees ownership (Marcus, expert).

Peer dynamics significantly influence adoption. Positive experiences within one department often spark curiosity and interest in others (Evelyn, operator). Employees frequently rely on informal networks to share insights and develop localised strategies, helping repurpose technologies to yield unforeseen benefits (Carroll et al., 2002; Kendall et al., 2020). Exoskeleton adoption often involves fundamental relearning: "I had to relearn how to work with an exoskeleton" (Olivia, operator) which can also highlight previously unnoticed problematic habits and postures (Emily, operator; Henry, operator). Informal peer knowledge sharing provides support during adaptation, with users warning about temporary leg pain while anticipating back improvement (Ethan, operator).

Embedded Routine: Collaborative integration and systematic feedback

Embedded Routine represents a progression from Local Experimentation to structural embeddedness. It represents the most effective pattern, characterised by comprehensive stakeholder participation and systematic feedback mechanisms ensuring sustainable technology integration. This culture encourages employee participation in decision-making and fosters collective ownership of technological systems (Wong et al., 2023). Employee autonomy is structurally supported, and managerial frameworks enable ongoing technological adaptation.

In practice, this requires organisational structures facilitating genuine participation through stakeholder discussion tables (Caroline, expert). Participation is sustained by trust, clarity, and transparent processes (Stella, expert), which help recognise employees as domain experts (Sophie, expert). Technology adoption is characterised by collaborative co-construction requiring extensive stakeholder involvement beyond direct users, including unions, supervisors, managers, physicians, ergonomists, and engineers. Knowledge is co-created rather than merely transferred. Implementation involves iterative collaboration through "cognitive walkthrough[s]" balancing employee expectations and employer intentions (Stella, expert). Communities of practice facilitate knowledge building by encouraging purposeful conversations that enhance the contextual understanding necessary for members to interpret and apply knowledge effectively (Hoadley & Kilner, 2005), within which knowledge is continuously refined and internalised through use.

Feedback is treated as an ongoing process embedded within daily operations. Effective feedback collection involves reflective practice that moves beyond surface impressions (Stella, expert) and must capture multiple dimensions through talking, observing, interviewing, and determining redesign needs (Kimberly, expert). When employees provide input into personalisation, it ensures "a better employee" (David, expert). Managers recognise feedback's role in helping employees feel "they are part of the business, part of the team" (Daniel, manager), a notion reflected by employees: "if we have something to point out, good or bad, we talk" (Henry, operator).

Successful integration often begins with positive initial technology uptake, where users embrace new tools when perceiving immediate, tangible benefits (Murray et al., 2010). Many employees expressed enthusiasm and motivation about participating in trials (Emily, operator; Ethan, operator; Olivia, operator). Employees with prior health concerns or greater occupational risk awareness demonstrate higher receptivity to exoskeleton adoption (Alexander, manager). This suggests that personal relevance and physical context remain key factors in long-term integration. The subsequent adaptation process involves gradual habituation where employees eventually cease noticing the exoskeleton during work activities (Henry, operator), representing successful integration through exoskeleton "transparency" (Philip, expert).

Sustained impact extends beyond device use, with employees reporting improved posture, "even without any preparation, it is more upright" (Noah, operator), and better self-perception: "you feel better about yourself, about your body and you feel more relief" (Olivia, operator). Management increasingly views exoskeletons as components of broader ergonomic interventions rather than standalone solutions (Michael, manager), reflecting understanding of comprehensive workplace health approaches.

Analytical implications: Navigating the matrix for human-centric adoption

The matrix makes the positionality of the technology adoption process diagnostically visible. By treating Embedded Routine as an optimal configuration, it clarifies what is lacking elsewhere, not as a normative judgement but as an analytical baseline against which other configurations can be interpreted. Our analysis reveals that this configuration depends on alignment between organisational discourse, material conditions, and user adaptations. Technologies may achieve formal embedding without meaningful user engagement (Formal Compliance) or generate strong user engagement without organisational support (Local Experimentation). Navigating between these configurations requires understanding both what sustains and what undermines each.

When adoption falls into *Marginal Use,* it signals fundamental misalignment between system design and deployment conditions. Our findings indicate that technical limitations – particularly movement restrictions, heat discomfort, and invisible frictions – overrode even well-resourced, formal implementation efforts. These problems are unlikely to be resolved through formal processes alone. This highlights the importance of participatory approaches that incorporate end users in the design and implementation stages, in order to tailor technologies to real needs and contexts (Steen, 2011), and the importance of integrating iterative feedback loops into project timelines (Carreno, 2024). Without intentional efforts to address these barriers, the technology is unlikely to advance beyond marginal status.

Formal Compliance indicates that technology is perceived as a managerial imposition. Our evidence shows that mandatory approaches generated resistance among participants, while productivity concerns created ongoing tension. These findings suggest that qualitative investigation of the gap between policy and practice, through walkthroughs and informal conversations, can reveal why deeper engagement is absent. Our analysis points to the value of creating space for situated practice, empowering teams to adapt usage protocols and addressing legitimate compensation concerns. Involving employees in these processes enhances commitment and diminishes perceptions of imposition (Alqahtani & Braun, 2021). By combining bottom-up engagement with top-down normalisation, organisations may create conditions conducive to Embedded Routine.

Local Experimentation, rather than threatening standardisation, represents latent organisational intelligence. Employees in our study developed adaptation strategies – from

strategic timing of device use to peer-to-peer knowledge sharing – that often exceeded formal implementation plans. Instead of suppressing "unauthorised" practices, the findings suggest that organisations could benefit from legitimising and learning from them. Establishing formal channels to capture employees' tacit knowledge could transform experience-based insights into organisational assets. Integrating these insights creates an environment that actively facilitates knowledge sharing among employees, thereby enhancing innovation capabilities (Oliveira et al., 2020), and establishing pathways towards Embedded Routine.

Sustaining *Embedded Routine* requires active maintenance rather than passive monitoring. Our findings suggest that protecting the autonomy of communities of practice, maintaining open feedback loops, and acknowledging collaborative success could prevent regression into Formal Compliance as organisational priorities shift. Sustainable technology integration depends on recognising employees as co-designers of technology application (Navarro-Meneses & Pablo-Marti, 2025). Formal systems are designed to support user-driven adaptation and learning processes; iterative feedback and collaborative problem-solving processes are key to maintaining engagement and supporting continuous improvement (Carreno, 2024; Shannon, 2021).

Discussion

Managerial implications: Four important considerations

The four quadrants represent configurations within an ongoing adoption process, not static classifications. Design choices determine whether movement between them is possible. By providing resources and structure, an organisation can potentially transform the bottom-up efforts of Local Experimentation into reliable practice, consistent with descriptions of situated co-production (Broadhurst & Mason, 2014; Crompton, 2019). Similarly, encouraging genuine user engagement can reconfigure the top-down requirements of Formal Compliance. If technological issues and user needs are ignored, any initiative risks collapsing into Marginal Use. Reaching Embedded Routine is only one aspect of reframing success; another is increasing an organisation's capacity to learn from each configuration and manage transitions between them. Our findings suggest that interference with natural movement rhythms represents a fundamental design concern: even minor restrictions provoked strong psychological resistance among participants, while heat and weight limitations eroded positive initial uptake over time. These findings align with recent exoskeleton studies that emphasise the role of perceived usefulness and long-term wearability in shaping user acceptance (De Looze et al., 2016; Andrade & Nathan-Roberts, 2022; Siedl & Mara, 2021; Wioland et al., 2025).

Second, our findings point to the importance of transparent communication in bridging credibility gaps. Invisible frictions, such as employees outwardly complying while covertly abandoning devices, can mislead organisations with false success metrics. Being clear about both the benefits and limitations of new technology implementation appears essential to

manage the social dynamics between "believers" and "sceptics", a point consistent with Dhondt et al.'s (2017) argument that open, reciprocal communication among stakeholders fosters positive industrial relations.

Third, our analysis indicates that implementation strategy shapes adoption trajectories. Mandatory implementation tended to trigger disengagement among our participants, whereas a guided voluntary approach relying on trusted peer ambassadors and social influence was associated with more successful adoption. This finding aligns with recent research confirming that peer endorsement within workplace networks accelerates innovation uptake and strengthens user commitment (Brykman & Raver, 2023).

Fourth, the findings highlight organisational readiness as a decisive factor. Successful technology adoption requires more than 'good' technology; it requires a supportive ecosystem including dedicated champions, adequate infrastructure, clearly defined issue-resolution protocols, and cultural alignment (Leonardi & Barley, 2008; Howell & Higgins, 1990; Schein, 2010). Without these enabling conditions, advanced technologies encounter difficulties in becoming integrated into everyday practices.

The matrix as a diagnostic tool

The matrix's value lies not in specifying what organisations should do but in making visible where they are. By identifying which configuration best describes a current technology initiative, organisations can assess their position and develop targeted strategies for progression.

Moving from Local Experimentation to Embedded Routine involves providing structural support, formalising successful informal practices and scaling up peer-led initiatives while preserving the enthusiasm that drives them. Our evidence indicates that individual variation in body types, job responsibilities, and personal preferences renders one-size-fits all approaches ineffective. Organisations should consider offering device selection, including aesthetic and design choices, to ensure alignment with employees' identities and comfort. Our analysis also suggests that exoskeletons may function as situational or educational tools to improve posture awareness. Daily appropriation patterns, where employees prefer task-specific use rather than continuous wear, point to the need for gradual familiarisation processes that accommodate individual rhythms of adoption. This finding highlights the importance of extended real-world trials over short laboratory demonstrations.

Moving from Formal Compliance to Embedded Routine requires transforming top-down mandates into collaborative adaptation processes through genuine user engagement and feedback mechanisms. Initial engagement strategies could target groups most likely to benefit, such as new employees or those with health concerns, to build momentum. Sustained adoption appeared to depend on whether the technology became "transparent'" to users, integrating into workflow without persistent intrusions. Combining top-down

structures with peer-led dynamics, where early adopters and respected employees can inspire enthusiasm and spark interest, may facilitate this transition.

Avoiding Marginal Use demands devoted attention to user needs, technological limitations, and continuous organisational learning. Low levels of both formal support and employee engagement signal that fundamental reassessment is needed to prevent initiatives from deteriorating into superficial adoption or abandonment.

Limitations and future directions

Several limitations require careful consideration. Firstly, this study is based on a single-case design, focusing on the physical and embodied aspects of exoskeletons. This approach may have amplified certain dynamics that are less pronounced for other technology types. The physical and embodied aspects of exoskeletons may intensify user experiences in ways our matrix captures well but which may be less salient for cognitive or purely digital technologies. Technologies such as AI decision-support systems may exhibit different dynamics along the situated practice axis, as their adoption depends more on cognitive integration and information flows. The matrix's utility for other technology classes remains an empirical question requiring validation through comparative studies across technology types (embodied vs. cognitive, physical vs. digital), which would help establish the matrix's scope conditions and identify necessary modifications for broader applicability.

Second, our observational data was collected during a week-long site visit. While this was complemented with 34 semi-structured interviews, the cross-sectional nature of the fieldwork represents a limitation, given that we frame technology adoption as an iterative, longitudinal process. The matrix's quadrants describe dynamic configurations that shift over time; capturing these shifts in real time would require sustained ethnographic engagement. Future studies could employ longitudinal methodologies, where employees use technologies over months or years, tracking how initial barriers or benefits shift and how configurations migrate across quadrants.

Third, we recognise that technology adoption reflects and reproduces existing power relations (Clegg et al., 2006). The Formal Compliance quadrant reveals the exercise of managerial prerogatives, while Local Experimentation represents employees' tactical responses to limited formal authority over technology choices. Future research could explicitly examine how participatory approaches can challenge existing power structures and whether the matrix can be used not only to diagnose configurations but also to facilitate more equitable participatory processes.

Conclusion

This study demonstrates that combining normalisation and situated practice perspectives provides a practical lens for understanding and improving technology integration in complex organisational settings. It argues for a reframing of success: moving away from a binary focus on acceptance or resistance toward a more nuanced appreciation of sociotechnical alignment. The Normalisation-Situated Practice Matrix provides the conceptual structure for this reframing, mapping visible the configurations through which technology adoption unfolds without reducing them to predetermined outcomes. As Pasmore et al. (2019) contend, ensuring human needs and social systems are respected and harmonised with the benefits of technology has never been a more critical concern. True success for technology integration, as becomes apparent in the case of exoskeletons, is an emergent property of the ongoing negotiation between users, designers, institutions, and cultural discourses, shaped by an organisation's ability to navigate the dynamic configurations of this process.

Technology adoption should be seen as a situated, iterative process. This aligns with both Suchman (2006) and Gherardi (2008), who indicate how technology use is shaped by local contexts, employee experiences and organisational realities, requiring continuous feedback, adaptation and co-creation. Our findings challenge the assumption that adoption failures stem primarily from user resistance or insufficient training, rather, successful adoption depends on organisational culture, social dynamics at the workplace and the alignment between institutional structures and embodied practice. Shifting to advanced technologies requires significant organisational investment, making correct adoption strategies crucial. Conventional, linear implementation approaches are insufficient. Success lies not in forcing compliance but in creating conditions where technology and human practice can adapt and evolve together, prioritising collaborative adaptation, informal peer learning and iterative feedback loops (Enkel et al., 2018). Exoskeletons and similar emerging technologies should be introduced as platforms for collaborative experimentation, enabling the co-evolution of technology, work practices and organisational processes. This signals a necessary shift toward more collaborative, sustained and human-centric adoption processes in organisations.

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Leader Change Engagement as a Boost for Workplace Development

Leader Perceptions from a Finnish Wellbeing Services County

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Abstract

In 2023, Finland implemented a major structural reform that created Wellbeing Services Counties (WSCs), which became responsible for organising public healthcare, social welfare, and rescue services. This reform transferred these responsibilities from individual municipalities to newly established regional authorities, with the aim of improving service coordination, accessibility, and equality across the country. This research focused on one mid-sized WSC. The research examined how change engagement and its dimensions were reflected in WSC leaders' and supervisors' descriptions of their leadership work. The data for this study comprised leaders' and supervisors' (N=92) answers to open-ended questions in an online survey. The data were analysed with a theory-driven qualitative content analysis. The research contributes new insights into leaders' change engagement and conceptualises it as a means of supporting both leadership engagement and well-being at work. In times when leaders report decreasing motivation and intentions of resignation it is more important than ever to find new ways of supporting enthusiasm and ensuring that public leadership work remains attractive. Job demands and resources theory (JD-R) provided us with a basis for analysing the leaders' work from the perspective of change engagement. The research showed that leader change engagement could be an important concept for understanding change as a resource in the leaders' work and well-being. Furthermore, it provides a new way of perceiving the connection between leaders' work and their well-being.

Key Words: work engagement, job demands and resources, change engagement, leadership

Introduction

Well-being, adaptation, and the ability to change are recognized as the foundations of sustainable organizational success (Bakker, 2022; Uusiautti & Hyvärinen, 2021) and as key positive features of organizations (Karasvirta & Teerijoki, 2022). However, not all employees and leaders find constant change appealing. While Finnish workers experience more work engagement than before, they are less optimistic about the changes occurring in their work, and both stress levels and intentions to resign have significantly risen among leaders (Suutala et al., 2025). This is not only a problem limited solely to Finland, but it occurs in public organizations internationally too (Ancarani et al., 2021). In large organizations, change management can be seen as an opportunity, but also as a burden in a leader's work (Harrison et al., 2021).

Traditional change management theories were developed when the idea of a career represented stability and straightforwardness, the world of work was more predictable, and leadership research was mainly interested in how to lead efficient work processes (Anderson et al., 2017; Gill, 2003). When we examine large public organizations and the requirements for increasing efficiency and flexibility, these theories alone do not serve organizational change management success sufficiently (Ferlie & Ongaro, 2022; see also Errida & Lotfi, 2021; Harrison et al., 2021). In addition to clear vision, values, and strategy, today's leaders need well-being skills and enthusiasm and motivation to carry out their leadership work in uncertain and stressful work situations (Gill, 2003). One concept to address this need is change engagement, which can be defined as "an enduring and positive work-related psychological state characterized by a genuine enthusiasm and willingness to support, adopt and promote organizational change" (Albrecht et al., 2020, p. 4).

We know that some leaders succeed better than others: leadership style, communication skills, and certain leadership traits can explain the leader's success (McGowan et al., 2020; Uusiautti, 2015; Uusiautti & Wenström, 2026). Leaders have personal resources that predict their performance and work satisfaction well (Bakker, 2022). Leader's work engagement (Bakker, 2022) and the ability to use their strengths at work (Sosik et al., 2019; Rautio & Wenström, 2026) certainly can provide grounds to understand successful leadership and successful change in organizations (Albrecht et al., 2020; 2022; Errida & Lotfi, 2021). Indeed, leaders are usually more enthusiastic and engaged in their work than other employees (e.g., Haapakoski et al., 2023). However, change engagement in leaders is not axiomatic because changes can increase the burden and negative emotions about work. Therefore, even the most enthusiastic leaders may not be enthusiastic about change.

Our research focuses on a Finnish public organization, one of the Wellbeing Services Counties (WSC) of Finland. The WSC reform is one of the most significant political and structural reforms to take place in Finland (Paatela & Tynkkynen, 2025), which makes the research context extremely crucial. Currently, WSCs face considerable changes that leaders have to (are forced to) lead, although at the same time the self-governance system of the organization itself is changing and evolving (Paatela & Tynkkynen, 2025; Paatela et al., 2025). The latest

news about WSCs has reported increased financial difficulties and layoffs since their establishment in 2023. Yet, these organizations must fulfil their legal obligations and provide healthcare, social, and security services to citizens. In addition, many leadership and supervision positions in WSCs are only part-time, meaning that, for example, a physician may work in a clinical role while also holding a leadership position (see, e.g. Perez, 2021).

The leaders' impact on employees' performance, engagement, and well-being at work is ambiguous in the healthcare, social services, and rescue services sectors (see, e.g. Pekkarinen et al., 2025; Selander et al., 2024). The sectors differ in the levels of enthusiasm and work drive the employees report, with healthcare workers reporting higher levels than those in social services, rescue services, and administrative work in Finland (Pekkarinen et al, 2025). In WSC-relevant occupations, such as in healthcare or rescue services, the nature of work and its often extraordinary conditions shape the meaning of successful change in distinct ways. Nevertheless, even when work-related challenges are complex or workloads are high, individuals can still become engaged in their work.

Finland's 21 WSCs employ about 230,000 workers. The WSCs differ greatly by the number of inhabitants in the area, varying from 100,000 to 550,000 inhabitants (Statistics Finland, 2023). In this article, we focus on data obtained in one Finnish WSC representing a mid-sized WSC with over 8,000 employees and about 176,000 inhabitants in the area. Typical for the WSC in question are long distances, uneven demographic development in the regions, and some intensive periods of tourism, setting high demands for rescue and healthcare services. Some parts of the WSC are suffering from demographic changes, such as an aging population, which challenges the WSC to achieve a balance between providing necessary services for citizens and developing new ways of serving them, for example, through digitalization (Kerätär et al., 2025).

While the heterogenous workforce in the WSC perceive their work to meaningful and are motivated, interaction, trust-building, and communication about ongoing changes by leaders appears insufficient (Rautio et al., 2025). A variety of educational interventions and leadership programmes have been introduced in similar situations worldwide (McGowan et al., 2020). However, more research is needed about the reality of leadership in changing public organizations especially concerning organizational transformations (Fernandez & Rainey, 2017).

Change Engagement as a Job Resource

This research leans on the theoretical framework of the job demands-resources model (JD-R), which combines demands and resources as psychosocial dimensions impacting well-being (Bakker et al., 2022; Demerouti et al., 2001). The basic idea of the framework is that certain demands reduce mental and physical resources (e.g., workload, unclear work roles, unpredictable changes), while there are also various resources (e.g., positive emotions, social support, interesting work tasks) that increase well-being at work (Demerouti et al., 2001). As

resources help employees cope with demands and achieve work-related goals (Bakker, 2022), they are important for work engagement as well.

In this research, we are especially interested in the change engagement of leaders themselves. The concept of change engagement is related to work engagement (Bakker, 2022; Schaufeli et al., 2006), which has been widely studied and used since Kahn (1990) introduced it and especially after Schaufeli and Bakker (2010) developed its quantitative measurement tool the Utrecht Work Engagement Scale (UWES). Work engagement is a positive state characterized by energy, enthusiasm about and dedication to work, and even complete absorption in work activities (Bakker, 2022). When comparing the concepts, change engagement is about positive attitudes, openness and readiness for change, or willingness and commitment to change at work, while work engagement describes a positive work drive and enjoyment of work. The concept of change engagement helps to analyse employees' positive energy and active involvement in organizational change (Albrecht et al., 2022). Notably, leaders' work engagement is a predictor of employee work engagement and performance, but whether that is the case in change engagement, is still unknown.

It is also worthwhile to distinguish change engagement from change-oriented behaviours in leaders (e.g., DeRue et al., 2011). Leadership behaviour as a concept means therefore behaviours that support employees and organizational goal-oriented performance. Thus, change-oriented behaviours comprise leadership behaviours that promote change, for example by encouraging and spurring employees on and working actively in change management tasks (e.g., Kaluza et al., 2021). Change engagement can be seen merely as an inner state which is positive and which promotes change-oriented behaviours. In other words, change engagement, as understood in this article, can lead to constructive, change-oriented behaviours in leaders (Kaluza et al., 2021). However, at this point in time there is not much research available on this topic, and therefore, our research will fill the research gap from the perspective of public sector leadership.

One reason for the lack of research is that leader's change engagement (LCE) has not previously been conceptualised as a positive, proactive state in leaders in times of organizational change. For instance, the leader's role in the change engagement model proposed by Albrecht et al. (2020) perceives the leader merely as an active supporter of change—emphasising clear communication about the importance and constancy of change, providing support and resourcing for ongoing change, and clarifying outcomes and behavioural expectations for change. In other words, change engagement appears in employees when it is supported by the leaders, also known as engaging leadership (Schaufeli, 2021; see also Tanskanen et al., 2019). When it comes to leaders, the expectation is that leading the change and making it happen is the leader's job (Errida & Lotfi, 2021), but the model does not consider the level of change engagement in the leaders themselves.

Our fundamental assumption is that LCE might fill the gap of how leaders perform successfully and may spread and facilitate the crossover of work and change engagement

within teams, as pointed out by Bakker (2022). Our core interest in this article is, therefore, in how the leaders describe *their own engagement* and the preconditions for their change engagement. CLE can provide new ways of understanding the leaders' own experience of the leadership reality within change (see also Salmi, 2024).

Method

The purpose of this research was to analyse how the WSC leaders and supervisors described their engagement with the change they were leading. In this article, we use the word "leader" to refer broadly to leaders and supervisors whose work consists of a variety of leadership tasks. We apply the definition by Malik and Azmat (2019, p. 24): "A leader is supposed to have the ability not just to manage or control the people, but also to inspire them; not only meeting goals and targets, but also able to create new goals and modify the existing ones according to the changing time, needs and challenges." This definition is useful because it covers both human resources management and the leadership of goals, development, and organizational culture. The research question set for this study was as follows:

How are change engagement and its dimensions reflected in WSC leaders' and supervisors' descriptions of their leadership work?

This was qualitative research and was considered appropriate for approaching this new perspective of leadership work and for gathering the leaders' own perceptions and experiences about their change engagement. The strength of this approach is that it allowed us to bring out the leaders' voices and interpret their experiences using the JD-R framework and the concept of change engagement. The data was collected using an online survey in the target WSC simultaneously among employees from all sectors (healthcare, social services, rescue services and administrative work) and personnel groups (leaders and supervisors n=185; other employees n=897). The survey consisted of structured questions about work-related experiences (such as motivation, optimism), relationships and interaction in the work unit, and perceptions of leadership work. In addition, the survey included two open-ended questions: the first allowed the respondents to explain their answers to the structured questions, and the second asked how "human-sized work" (the target WSC's workplace slogan) was reflected in their daily work. The open-ended questions to which the leaders responded were included in the analysis of this research. Answering these open-ended questions was voluntary.

All together 92 leaders responded to these questions so that 56 leaders answered the first question and 74 answered the other question. Of these 92 respondents six were men, 85 were women, and one other/did not wish to say. Two were under 29 years old, 46 were between 30 and 49 years old, and 44 were 50 years old or older. They had work experience in the field as follows: 0–4 years (n= 5), 5–9 years (n=13), 10–15 years (n= 20), and over 15 years of experience (n=54). The respondents represented all four sectors of the target WSC, which was considered important for the quality of data. The respondents represented the

target population of leaders well. However, more importantly, their answers were considered rich and varied, which was essential for capturing diverse perspectives and experiences among leaders (Hansen et al., 2025).

The chosen analysis method was a theory-driven qualitative content analysis (Hsieh & Shannon, 2005). We analysed the free-form responses from the leaders and supervisors using the dimensions of change engagement defined by Albrecht et al. (2020): enthusiasm for change, involvement and participation in change, focused energy toward change, willingness to actively support change, and striving for successful change outcomes. Therefore, the theory guided the analysis although otherwise the analysis was data based, which meant that we listed all the mentioned elements of change in the answers and compared how they represented the definition of change engagement. The descriptions that could be placed in the categories of *willingness to actively support change* and *striving for change success* appeared to overlap in the leaders' responses, and therefore, these were combined into a single result category. Eventually, the following categories were formed from the data: 1) enthusiasm for change; 2) participating in change; 3) focusing energy for change; and 4) willingness to actively support and strive for change success, each including their distinctive data-based sub-categories as our main findings.

Results

Enthusiasm for Change

Enthusiasm for change can serve as an important resource in a leader's work (Bakker et al., 2023), particularly when it is manifested through affective states—such as perceiving the change as important, viewing one's role in the change as crucial, and finding one's actions in the change process inspiring. If there is a tension between the leader's enthusiastic state and opportunities to enjoy their work, the demanding sides of work, such as unclear roles or processes, can weaken this resource (Albrecht et al., 2020). In the leaders' answers, enthusiasm appeared mainly through three kinds of experiences, reflecting the tension between resources and demands in their work.

The first and the most common notion involved *feelings of frustration*. The leaders were frustrated about decision-making processes and desperation in the work community. They reported that their enthusiasm had been replaced by negative feelings, such as mistrust and desperation, and a sense of indifference sometimes arose. The extracts below illustrate these sorts of feelings:

> "The decisions for the future that concern me are dampening and discouraging me, and I don't have the enthusiasm to develop things anymore."

(Leader no. 43, over 15 years of work experience)

> "The situation is somewhat desperate and sometimes I have a feeling that I don't care. - - I don't care anymore or even talk about it, sorry."

(Leader no. 19, 10-15 years of work experience)

Their *enthusiasm had been deteriorating*. The most often mentioned reason for this was the continued state of uncertainty about the future. While the leaders had to worry about how their own work would change or what would happen to their units, they felt that they could not work properly and perform their core tasks at work, as one of the participants explained:

> "The constant change and the uncertainty involved with it takes my focus away from the work itself."

(Leader no. 53, 10-15 years of work experience)

However, some leaders also had *positive feelings about change* and perceived their own work positively, which was an important resource for them. They considered that they had a chance to develop their work and contribute to the change, which increased their enthusiasm. Some also mentioned that they had received positive feedback either from their subordinates and colleagues or customers (e.g., patients), which boosted their enthusiasm for change. The following extracts illustrate this view:

> "However, I am quite a development-oriented person, and I like it when I have a chance to develop operations and be part of the change."

(Leader no. 16, 5-9 years of work experience)

> "Positive feedback has strengthened my perception of being on the right track."

(Leader no. 59, over 15 years of work experience)

Overall, enthusiasm for was reflected in both positive emotional experiences at work but also in their lack or decline, illustrating the tension between resources and demands in the change situation from the leadership perspective. Negative perceptions were related to uncertainty and the inability to participate in the change, which will be reported in further detail next.

Participating in Change

Among the leaders in our data, participation in change described how well they perceived that they could influence or contribute to the change, and which factors they identified as supporting or hindering their participation.

The first category was: *limited participation due to unclear roles and communication*. As the WSC was still evolving and in the process of organizing its management system, the leaders reported that many of them did not really understand their responsibilities and decision-making power. This led to unwillingness or inability to take control over development

processes. They reported challenges in their induction for their tasks, but it was also a question of communication: many leaders mentioned changing and unclear guidelines, contradictory operations, and differences between units and sectors. The following extracts from the data illustrate these views:

> "There are too many supervisor hierarchies, due to which supervisors' work and leadership are really confusing. We just delegate things downwards to the next supervisor and don't bear responsibility from the point of view of our own leadership role."

(Leader no. 39, over 15 years of work experience)

> "The supervisors' work is challenged constantly by the unclear and inconsistent guidelines. What was given today as our task will be cancelled or changed tomorrow. - - Different services and sectors are operating inconsistently; some are following the given guidelines, others are not."

(Leader no. 74, over 15 years of work experience)

The second category was: *inequal opportunities for participation* and *ostensible participation.* The leaders described situations in which some of them or their units had not been allowed to participate in planning the change. Some leaders also had noted that in the wide area that the WSC covered some parts of the organization were not given an equal opportunity to participate due to long distances or smaller numbers of citizens they were serving, etc., as one of the participants explained:

> "[xx] personnel have not been invited to participate in planning at all and informing us about the future changes has been really dissatisfactory."

(Leader no. 29, 0-4 years of work experience)

Ostensible participation was also reported. The leaders had found that decisions may have been made already before the meeting took place. In some cases, the leaders had participated in meetings but did not have any chance to contribute to the changes or developments, as one of the participants explained:

> "In the meetings, we have ostensible discussions about things but the decisions have been made already before the meeting and you can't influence the decisions. - - If I could do my current work somewhere else, I would resign from [the WSC] immediately."

(Leader no. 55, over 15 years of work experience)

Thirdly, the leaders reported about their own *willingness to participate in the change*. They also realized that they had a significant role, and their own abilities were important for making the

change happen. These leaders appeared to be optimistic about the change and their participation opportunities, as the quotation below illustrates:

> "In this unstable economic and change situation, I see myself in a crucial [supervisor's] role for making the "human-sized work" concept come true."

(Leader no. 37, 10-15 of work experience)

The three categories revealed that while the sense of being able to participate was a clear resource for change engagement, this was not true for all leaders. Some of them felt left outside or given just an ostensible role in the change, indicating that change participation and involvement did not function as a change-related job resource (see Albrecht et al., 2020) equally for the leaders in this data.

Focusing Energy for Change

Emotions and participation do not fully describe change engagement: a leader must be able to direct their energy for change in their everyday work. The leaders in this data described how they could focus on the successful leadership of change and prioritizing change work.

On one hand, the leaders reported that the demands were high and they were overloaded with work which made them feel *insufficient and not being able to focus energy for change*—neither their own nor their followers' energy. They wanted to do their basic tasks first and hoped for better chances to be more energetic about the change too. Often, the leaders mentioned that they did not receive enough support for their leadership and supervision tasks, which was a crucial notion because social support is one of the key resources at work boosting engagement (Bakker, 2022). The following extracts from the data illustrate this aspect:

> "The immediate supervisors have simply too much work. - - The option is to do well (=you are doing overtime) or do the mandatory tasks just barely without developing anything (=during work hours)."

(Leader no. 60, over 15 years of work experience)

> "I have to be flexible at work all the time and my office hours are not enough for doing all tasks. I experience feelings of insufficiency at work."

(Leader no. 85, 5-9 years of work experience)

> "The idea of "human-sized work" seems like a joke in my work. - - I don't get any support for handling the challenging workload."

(Leader no. 2, over 15 years of work experience)

On the other hand, some leaders found their work very *autonomous*, allowing them to focus energy on change. Change autonomy can be a highly important change-related job resource (Albrecht et al., 2020). The crucial notion was that when the leaders had the perception that they could control their work tasks and contents, plan their schedules, and genuinely contribute and lead the change, they felt that they could also prioritize the change, as the following quotations from the participants illustrate:

> "I think that I have a job in which I can influence and develop things. - - I can design my work so that I have a balance."

(Leader no. 91, over 15 years of work experience)

> "I pretty much lead my own work. I am an independent employee, and I like to have plenty of responsibilities and autonomy at the same time. I can prioritize my work as I think is the best."

(Leader no. 47, 0-4 years of work experience)

The contradictory categories mentioned above regarding focusing energy on change revealed how demands and resources were evident in the leaders' perceptions. In particular leaders with relatively clear job descriptions and responsibilities also reported more positive evaluations. The clarity of the leadership role is also closely connected with the sense of autonomy and the ability to plan one's own work and where the energy is focused, supporting the leaders' change engagement.

Willingness to Actively Support and Strive for Change Success

Finally, the fourth category describes how persistently and willingly the leaders are ready to put effort into making the change come true as planned. This category illustrates how change engagement is shown in practice as actual persistence and devotion to change. In this category, too, the leaders' perceptions vary, showing the imbalance between resources and demands in their work.

First, some leaders reported that they could *not strive for change success*. The demands from their work were overwhelming, and they had too many administrative tasks and daily problems they hindered them from supporting and striving for change. The extracts below illustrate this view:

> "Clarifying the goals and how to reach them requires time from the supervisor, which I don't have in this situation because human resource management and problem-solving take so much time and there is no time even to do my basic job."

(Leader no. 90, 10-15 years of work experience)

> "At the moment, work is a lot bigger than the human being doing it. The demands from our leadership have been overwhelming since last spring, e.g., schedules for tasks have been impossible."

(Leader no. 3, over 15 years of work experience)

Some factors were *slowing down the leaders' efforts*. Unclear organisational processes consumed time and energy, and ambiguous work roles resulted in chains of delegating questions from one person to the next. In addition, unclearly communicated goals and strategic objectives made the leaders struggle to find out what was expected from their units and how they could meet the goals. The following excerpts from the data express this view:

> "We have to exchange emails on the same issue for several days. This slows down working and getting issues solved."

(Leader no. 12, over 15 years of work experience)

> "I wish we had more concrete strategic goals - - and mutual discussions about them. - - What is expected from me and my unit, and how we can achieve it. And I would hope that this would be explicitly described for example at the unit level so that everyone would have the same means and aspirations to reach the goal."

(Leader no. 86, over 15 years of work experience)

The third category revealed the leaders' *positively perceived actions and efforts*. They mentioned how they could boost the "we" spirit in their units and explain the reasons for change and their goals to their subordinates. They perceived that they had a key role in supporting their subordinates and were striving for the change to be a success in their teams. These leaders also considered their own way of embracing the change and working for it as setting an example for others in their work units, as the following quotations from the participants show:

> "We work as a team and go towards the goal together. No one will reach anything alone."

(Leader 77, 0-4 years of work experience)

> "Listening and understanding; we help and look for means to cope with challenges in life or at work together."

(Leader no. 81, 5-9 years of work experience)

While striving for change success was challenged in various ways that related mostly to the formation phase of the organization, some leaders also had positive experiences of being change agents. They could also inspire their teams and units to support change through their actions. In this sense, striving for change success appeared not only as the leaders' own

resource but also a resource for others through their inspiring action and dedication (Albrecht et al., 2020).

Discussion

Our analysis showed that leaders' change engagement appeared as a multidimensional phenomenon in which their aspirations to perform well in their leadership role and the realities of their current workload strongly influenced how they perceived their ability to lead the change actively or just merely go with the flow or act as bystanders.

When considering the elements of change engagement (Albrecth et al., 2020) and how they were reflected in the speech of leaders in our data, it appeared that when leaders were well embedded in their work and clearly understood their responsibilities and mandates—i.e., were able to work autonomously, and experience a sense of leading the change—change engagement could emerge as a multidimensional resource at work rather than solely as a burden or demand (cf. Bakker, 2022; Bakker et al., 2023). This finding is in line with Paatela et al.'s (2025) research whose findings also showed the need for clarity in responsibilities and mandates as roles are established or redistributed in the WSC.

In this research, enthusiasm and willingness to strive for change success appeared somewhat conditional on the actual sense of being able to participate and direct energy towards change. This means that when the workload and autonomy over prioritizing work are in good balance, leaders can become inspiring change agents. Otherwise, their enthusiasm starts to decrease, and they are no longer willing to put in the effort. This finding is similar to Farhan's (2021) research pointing out that leaders just having certain competencies is not enough if they do not have the belief and persistence to reach the goals in their work.

However, this connection between the elements of change engagement in leaders' experiences needs to be analysed more thoroughly so that the causal relationship can be verified. Still, the value of hearing the leaders' experiences and emotions related to the change revealed crucial aspects concerning the change in a large organization such as the WSC in question.

Based on our findings, it is not possible to assume that leaders automatically feel emotionally connected to the change and are ready to strive for change success. Unclear responsibilities in daily tasks, communication misunderstandings, and perceived inequalities can undermine leaders' genuine efforts and diminish their positively oriented engagement with both their work and ongoing workplace changes. Namely, there are sectors that have been working for a long time, such as the healthcare sector, and the leadership structure is well established. The support services, at the other extreme, represent a somewhat new sector in WSCs, because previously the support services such as human resources management, research services and administration, have been under the responsibility of the municipalities (Paatela & Tynkkynen, 2025). Therefore, the leaders' change engagement can appear differently in

different sectors: they may have a long history in a certain kind of organization and were now entering a new, larger structure with increased hierarchy. While older leaders may rely on their previous experience (e.g., Quinn, 2015), this experience can sometimes become a burden, too. Younger leaders may find structural immaturity a change-related demand in their work through unclear roles or responsibilities, but they may also find it an opportunity to create their own way of leading the change. It would be important to focus on each leader's personal situation, attitude, and history with the leadership task in order to find the best way to support their change engagement. Qualitatively oriented research studies—such as the one at hand—can thus provide important information about the actual experiences among leaders themselves and give space to their voices without the fear of becoming judged as a bad leader only because they perceive the resources and demands in their work differently.

Concerning the reliability of this research, we follow the four main criteria for qualitative research (Shenton, 2004). The situation the WSCs in Finland are facing currently was described in the introductory part of this article: the change is prominent and challenging in many ways. To ensure *credibility*, we have pointed out both positive and negative experiences, aiming to provide a profound picture of the phenomenon investigated in this research. The description of the context is important also for *transferability*, so that the reader can decide whether the prevailing environment is similar to another situation—in this case, we assume that reforms in large public organizations represent the target context and how the leaders themselves experience their work within the changes. Although the criterion of *dependability* is somewhat difficult to meet in this kind of qualitative research, we have tried to provide as detailed a description of the implementation of this research as possible. For *confirmability*, we have leaned on researcher triangulation meaning that both of the researchers have analysed the data and compared our interpretations to avoid sticking to our own assumptions or predispositions. Our role as independent researchers without a role in the target organization has also helped us to analyse the data objectively. In addition, we have used a theory-driven content analysis to guide us with the search of perceptions about change engagement. Finally, the leaders' responses to survey and the quotes from the data illustrate how they perceive their work.

Naturally, there are limitations to this research. We acknowledge the fact that not all leaders and supervisors from the target WSC responded to the survey, and from those who did, only about half (49.2%) responded to the open-ended questions. However, the number of responses and the richness of the experiences described in the answers showed that with this analysis method it was possible to draw a picture of the leaders' change engagement and bring out unique experiences of the leaders. In the data, the majority of the respondents were women, which does not fully correspond with the overall gender distribution in the leadership positions in the WSCs (Laine, 2024). We can only make assumptions of why female leaders were more willing to answer to the open questions than men and how the data would have been different if the questions had been mandatory. In general, we did not find any implications related to the gender of the leader in the data, and thus, consider that the issues brought up regarding change engagement were not gender specific per se. On the other

hand, it was important that leaders with various levels of experience and from different sectors were well presented in the data.

Conclusion

This research presented some theoretical and practical insights. First, the concept of leaders' change engagement was expanded beyond their role in inspiring their followers to encompass the leaders' own perceptions of their work, offering a more specific lens than work engagement alone. When viewed through the lens of the JD-R framework (Bakker et al., 2022), tensions between resources and demands were evident in all elements of change engagement: it can be a resource for leaders, although it may be undermined by avoidable demands, such as unclear roles and responsibilities (see also Cameron, 2008; Quinn, 2015).

According to prior studies, the nature of the public sector leaders' tasks and being able to reach beyond themselves have been identified as motivational factors that strengthen their engagement (Peretz, 2020). Similarly, Ancarani et al. (2021) suggested that the interconnections between leadership, change implementation, and work engagement may help explain the capacity to promote public sector change. Therefore, in our research, change engagement was considered as a more specific form of engagement in the leaders' work—that is, engagement occurring during a drastic change in the organization. The target WSC provided a good context for this analysis because the WSCs in Finland are undergoing a phase of transformation, as they attempt to focus on the future and find a way to deal with their past as municipal service provides. This was expected to add valuable new perspectives to the strategic management of public sector organizations, as requested by Ferlie and Ongaro (2022).

Practice wise, the study showed how important it is to acknowledge leaders' change engagement, and to determine how to best support them in meeting the demands of change management and change leadership. This need was also noted in earlier research (Gill, 2003). A key practical question is how to enhance leaders' participation and foster a sense of ownership of the changes, even when roles and responsibilities remain unclear. Our findings indicate that vertical communication is crucial to ensure that the leaders understand the meaning and purpose of change and can communicate it to their own teams. This was evident from our data. Strengthening a shared understanding of the change process and its necessity would also strengthen the collective alignment among leaders and supervisors and support their joint change engagement.

Another suggestion for enhancing the leaders' change engagement is to systematically create opportunities for peer support. In our data, leaders reported that they did not have clear channels for discussing questions, concerns, and solutions with colleagues at the same hierarchical level. However, in times of uncertainty, peer support can serve as a valuable resource by fostering shared enthusiasm, a sense of participation, and enabling the practical exchange of strategies to direct energy and strive for change. Peer support channels could

also improve communication within the organization and create a shared understanding of the situation. While the role of social support has been previously acknowledged as an important resource at work (Bakker et al., 2022), its significance for leaders' effectiveness and success at work remains less explored. This conclusion is in line with Tafvelin et al.'s (2019) research, in which they found that leaders who had better peer support also engaged better in transformational leadership.

Peer support in the context of this research does not necessarily mean formal support groups *per se* but merely systematically arranged channels and forums that would allow the leaders to openly discuss their solutions and concerns and share information and ideas for development. Peer support among leaders and supervisors could also enhance the development of a more empathic work culture (Arghode et al., 2022), thereby fostering more positive engagement with the changing organization. This would be worth testing in various formats, such as face-to-face encounters, but also in online groups, because in the target organization of this research leaders might be working hundreds of kilometres in distance from each other.

Job demands and resources theory provided us with a basis for analysing the leaders' work from the perspective of change engagement in this research. While the ultimate goal in JD-R has been to improve employees' well-being and organizational performance (Tummers & Bakker, 2021), we argue that leader change engagement could be an important concept for understanding change as a resource in the leaders' work and well-being. Furthermore, it provides a new way of perceiving the connection between leaders' work and their well-being. For example, Kaluza et al. (2021) have noted a lack of research in this area, claiming that the question of how leadership relates to leaders' own well-being is not yet fully answered. More research on the connections between work engagement and change engagement in leaders is also needed to find new ways to support leaders' well-being during reforms in large public sector organizations.

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The authors report there are no competing interests to declare.

Data Availability Statement

The data that supports the findings of this study are available from the corresponding author, [SU], upon reasonable request.

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Conditions for Workplace Innovation in a Public Organisation

A Domino Effect of Emerging Barriers

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Abstract

Previous studies have shown that innovation processes in public sector organisations are difficult due to various innovation barriers inherent to the public sector, but few studies have empirically explored the barriers in a way that is close to organisational practices and conditions for successful innovation remain unclear. Therefore, the purpose of the paper is to explore and discuss conditions for workplace innovation in public sector organisations, with particular focus on the conditions that enable and constrain an innovation process in such organisations. The paper builds on a qualitative case study of an innovation process in a Swedish municipality. The process was studied from development and testing of a new approach to the provision of health and care (H&C) until the early stages of adoption of the new approach throughout municipal H&C operations. The findings show that the conditions that enabled the innovation process primarily related to the initial stages of the process, when developing and testing the new approach to H&C, while barriers that emerged as particularly strong in the implementation phase slowed down and hampered the innovation process. There were two types of barriers that constrained learning, those stable over time and those that emerged during the innovation process, and the barriers were formed in a complex pattern of domino-effects raising through overhead municipal departments and administration systems.

Key words: workplace innovation, conditions for learning, conditions for innovation, barriers to public sector innovation, municipalities

Introduction

This paper focuses on workplace innovation in public organisations, particularly the conditions that enable and constrain an innovation process. Such a process is viewed as a process that entails the development of a new idea, that creates value, and is taken in use (cf. Mulgan, 2007). Innovation refers to "the introduction of something new (an idea, product, service, technology, process, and strategy) to an organization" (Demircioglu, 2016, p. 1), and for the 'new' to qualify as an innovation it needs to be implemented. Nevertheless, researchers often study innovation generation and adoption phases separately, perhaps because workplace innovation processes are complex, not least because new ideas are often generated and tested in one organisational location and adopted or implemented in others (Damanpour, 2020). Separate generation and adoption locations seem to be the case in Swedish municipalities, drawing on studies of innovation processes in this type of public organisations (Lidman, 2023; Nählinder & Fogelberg Eriksson, 2017; Wihlman, 2014). Furthermore, the early stages of innovation processes, such as development of new ideas, seem to attain more support in municipalities than the actual implementation of the new ideas, which may hamper innovation processes (Lidman, 2023; Nählinder & Fogelberg Eriksson, 2017).

It is suggested that public sector innovation is a mean to mitigate challenges, such as budget deficits and increasing citizen needs, that public organisations often face when providing public services (Albury, 2005; 2011; Torfing et al, 2021). In addition, workplace innovation has been put forward as an important mean to attract and retain public sector workers and professionals (Steijn & Knies, 2021). Previous studies have however shown that innovation processes in public sector organisations are difficult due to various innovation barriers, inherent to the public sector (Cinar et al, 2019). These barriers relate to e.g. risk aversion, organisational inertia, silo structures, complex budgetary processes and tight budgets (Brown & Osborn, 2013; Stewart-Weeks & Kastelle, 2015; Torugsa & Arundel, 2017). There are also limited possibilities in allocating resources to the support of innovation activities in public sector workplaces, which may function as barriers to innovation processes on the workplace level (Lidman et al, 2023; Wihlman et al., 2016). However, the view of barriers as distinct antecedents of innovation has been criticized for being overly static, as it neglects the potentially dynamic features of barriers in relation to innovation processes and outcomes (Alteneiji et al., 2025; Cinar et al., 2019), also in large public organisations (Halvarsson Lundkvist & Gustavsson, 2018). While research on public sector innovation has grown substantially, previous studies have tended either to focus on discrete barriers or to analytically separate phases such as idea generation and implementation. Consequently, limited attention has been paid to how enabling and constraining conditions evolve dynamically across different phases of the innovation process, particularly at the workplace level in large public organisations. This gap is significant, not least because few empirical studies have explored innovation processes in ways that are close to organisational practices (Gallouj & Zanfei, 2013), and because the conditions for successful innovation remain insufficiently understood (Liarte et al., 2025).

Against this background, the purpose of the paper is to explore and discuss conditions for workplace innovation in public sector organisations, with particular focus on the conditions that enable and constrain an innovation process in such organisations.

This paper contributes to public sector innovation research by offering a processual and learning-oriented analysis of workplace innovation. Empirically, it provides a longitudinal, practice-near account of how enabling and constraining conditions emerge, interact and intensify when an innovation process moves from development and testing towards implementation. Theoretically, the paper intervenes in debates on public-sector innovation barriers by conceptualising them not as static antecedents but as dynamic learning conditions that unfold over time.

By integrating perspectives from workplace learning theory, the paper advances understanding of how public organisations may become capable of both developing and sustaining workplace innovations. In particular, the study highlights collaboration as a central mechanism through which learning conditions shape the trajectory of public-sector innovation processes.

The paper builds on a qualitative case study of an innovation process in a Swedish municipality. The process was studied from development and testing of a new approach, including new work methods and processes coupled with it, to the provision of health and care (H&C) until the early stages of adoption of the new approach throughout municipal H&C operations. The innovation process was managed by a project leader and change leaders at the central municipal level. Employees (first-line unit managers and healthcare professionals and workers) contributed with knowledge and suggestions throughout the testing and development of new work methods and principles of organising that originated from a change of view on patients and recipients of care (hereafter referred to as 'the citizen'). The goal was to implement new work processes in which citizens were viewed from a salutogenic perspective, i.e. focussing on rehabilitation and what the citizens could manage by themselves or could be supported to do, instead of what they could not do by themselves. The next sections present the theoretical framework of the study, the research setting, methodology, findings, and finally discussion and conclusions.

Theoretical framing

The theoretical framework combines several strands of literature to analyse conditions for workplace innovation in public sector organisations. Theory on workplace learning and the concept of learning environments constitute the primary analytical lens guiding the empirical analysis. This perspective is used to examine how learning conditions enable or constrain collaboration and learning throughout different phases of the innovation process.

Employee-driven innovation (EDI) provides a complementary perspective that foregrounds employees' active role not only in idea generation but also in the development and

implementation of new work practices. Finally, the concepts of exploration and exploitation, and organisational ambidexterity, serve as sensitising concepts that help to interpret temporal shifts in dominant learning conditions as the innovation process moves from development and testing towards implementation.

Workplace innovation, with its focus on employee involvement and a participatory process of innovation (Totterdill & Exton, 2021), is closely connected to workplace learning (Billett, 2012; Ellström, 2010; Engeström, 2001). In essence, the innovation process entails searching for "something that is not yet there" (Engeström & Sannino, 2010, p. 2). Even so, development of a new way of working starts in already existing work methods in most organisations (c.f. Ellström, 2010; Engeström, 2001). The innovation process itself starts with an idea that is new to the organisation, and it involves testing and evaluating the idea, to further developing it before eventually implementing it (Nählinder & Fogelberg Eriksson, 2019). This process has been depicted as a learning cycle that begins with questioning and analysing the current way of working and, under the right conditions, ends with the implementation of something new (Engeström, 2001). Groups of people who go through the cycle together may have different motives and, if a conflict of motives occurs, learning and thus also transformative action may be constrained. Conversely, if resolved, conflicts of motives can also be drivers of expansive learning, that is, learning that promotes transformative actions towards something new (Engeström, 2001; Engeström & Sannino, 2021). Learning is then about mutual engagement in activities that involve negotiations of meaning (Fuller et al., 2005).

In an established organisation, with set work processes, employees' creativity, and work-related knowledge, deriving from everyday work may enhance the evaluation and testing of the new and thus also the organisation's innovative capacity (Ellström, 2010; Evans et al., 2011; Halvarsson Lundkvist & Gustavsson, 2018; Høyrup, 2010). The notion of employee-driven innovation (EDI) takes it further, as it also encompasses the implementation phase of the innovation process (Høyrup, 2010). Billett (2012) states that EDI is necessary in organisations because it is employees, who actually, through their work, encounters job-related challenges. This is also shown by Ellström (2010), in what he refers to as practice-based innovation, in which innovative behaviour, when job-related challenges arise, can lead to implementation of new work methods throughout the organisation.

Since employees mainly learn through their daily work, those who support EDI must have detailed knowledge about the employees' job tasks (Amabile & Pratt, 2016, Cangialosi et al., 2020). Nevertheless, supporters of EDI must also meander through organisational conditions that may constrain learning (Billett, 2004; Derrick, 2020; Evans et al., 2006; Evans et al., 2011; Gustavsson, 2009), and thus also hamper the workplace innovation process (Halvarsson Lundkvist & Gustavsson, 2018, Lidman et al., 2023). Accordingly, an organisation's innovation capacity may all be a matter of workplace design (Ellström, 2011). Organisational conditions both interplay with employee engagement and have a direct effect on employee engagement (Billet, 2001; Lidman et al., 2023). Depending on the number of conditions that enable and constrain learning, the environment in which learning (throughout the innovation process)

takes place can be labelled as restrictive or expansive (Fuller & Unwin, 2004; 2011). In expansive learning environments various voices are utilized in dialogues, problems are solved across different organisational levels and departments and competence-development activities are aligned with the organisation's goals or objectives (Fuller & Unwin, 2011). On the contrary, in organisations with restrictive learning environments, employees are predominantly trained to learn their job, not to develop the work method or processes coupled with it (Fuller & Unwin, 2011). Thus, an expansive learning environment is more likely to support the creativity and innovation capabilities of people than a restrictive one (Billett, 2012; Ellström, 2010; Evans, 2012; Fuller & Unwin, 2011; Fogelberg Eriksson, 2014).

Returning to the conditions that either enable or constrain learning, a multitude of these have been found in the literature. These conditions relate to e.g. organisational structure, organisation of work, support from change leaders and managers, arenas for collaboration, time and other resources, such as access to HRD activities (Deutscher & Braunstein, 2023; Lidman et al, 2022; 2023). Following the stylized logic of an innovation process: generating new ideas, developing them and implementing them, it has been discussed that conditions vary in importance during the innovation process (Rosing et al., 2011), requiring ambidexterity to support public sector innovation (Criado et al., 2025). As have previously been pointed out, generation of ideas and creative search for alternatives (cf. *exploration*, March,1991) is supported by learning conditions such as encouragement and resources to experiment, taking risk and allowing errors. Adoption or implementation of the innovation is supported by learning conditions such as specific guidelines, monitoring of goal achievement and established routines (cf. *exploitation*, March, 1991). This points to the dynamic features of conditions for learning in relation to organisational innovation processes, and a continuous need for balancing and coordinating these throughout the organisation (Lam, 2005).

Methodology

The paper builds on a qualitative case study of an innovation process in a Swedish municipality. The process was studied for two and a half years, from development and testing of a new approach to the provision of health and care (H&C) until the early stages of adoption of the new approach throughout municipal H&C operations. The researchers followed the innovation process and reported and discussed initial results from data collection with the participants. The research was carried out in accordance with ethical research principles, e.g. informed consent, and data was handled with confidentiality (Swedish Research Council, 2024).

Data collection

Data was collected through interviews (two sets of interviews, in total 19 interviews with first-line managers, change leaders and H&C workers), participant observations of meetings (10 workshops with first-line managers or H&C workers led by change leaders), notes from meetings with the project leader and/or project affiliates, formal documents relating to the

new approach to H&C, and three reflection seminars where top managers, first-line managers and change leaders took part of the preliminary research results that were presented by the researchers and discussed by the participants. Table 1 gives an overview of the data collection methods and data.

Data collection methods	**Data**
Interviews	In total 19 interviews (transcriptions): First set: 11 face-to face interviews with change leaders (2), first-line managers (5), senior management (2), nurses' aide (1) and assistance officer (1). Second set: 8 online interviews with first-line managers (4), occupational therapist (1), change leaders (2), project leader (1).
Participant observations of meetings	Notes from observations of internal meetings / workshops. In total notes from 10 observations (5-7 typed A-4 pages each): Five meetings for first-line managers Two meetings for nurses, occupational therapists, physiotherapists, and other professions Three meetings for nurses' aides
Notes from meetings	Notes from meetings, in total notes from 13 meetings: One onsite meeting with project team, including project manager and 5 change leaders One onsite meeting with two top-managers Eleven meetings with project leader, online or phone
Documents	Written material/documents in the form of: PowerPoint presentations and folders Official and service letters Project summaries Project final report Implementation plans
Participation in reflection seminars	Reflection seminar notes from three online seminars (12 typed pages in total). Participants in the online seminars: Seminar 1: Steering group members of which some had been interviewed and project leader Seminar 2: Other interviewees first set of interviews + colleagues Seminar 3: Steering group, change leaders and project leader

Table 1. Data collection methods and data, an overview

Interviewees were selected in collaboration with the project leader that was responsible for the innovation process (generation and adoption of the new approach to H&C in the municipality). Important criteria were that the interviewees had insight into or had taken part in the innovation process. The project leader was instructed to propose both individuals that

had been positive to the development of the new approach and those that were more cautious or opposed to it or the changes suggested by it. The final decision on who to interview was the authors'. Both authors participated in the data collection in equal amount. The interviews were semi-structured and based on interview guides that included both similar and different themes and questions for the two interview sets. The themes are presented in table 2.

First interview	**Second interview**
What is the new for whom?	
Organisation of the innovation work	Organisation of the innovation work and its main activities
Goals or expectations	
Conditions that enable or constrain the innovation work	Conditions that enable or constrain the innovation work
Support to unit managers	
Employee participation	Employee participation
How the innovation process is communicated	
	Results and effects of the innovation
Thoughts about the future for the new approach	Thoughts about the future for the new approach

Table 2. Themes of the interview guides, first and second set of interviews

The 11 onsite interviews from set one lasted 45 minutes on average and the eight online interviews in set two averaged 25 minutes. Interviews were recorded and transcribed verbatim.

Data analysis

Data analysis was conducted in several iterative steps. An initial, descriptive analysis was carried out continuously throughout the research project to follow the unfolding innovation process. Both authors engaged in this phase by jointly reading field notes, interview transcripts and documents, and by discussing emerging observations with participants during reflection seminars.

Subsequently, interview transcripts from each interview round were analysed separately using a data-driven thematic approach inspired by Braun and Clarke (2006). Both authors independently coded the material, focusing on empirical instances of conditions that appeared to enable or constrain learning and innovation during different phases of the process. Coding was performed iteratively, including several rounds of comparison and refinement.

Analytical disagreements were discussed until consensus was reached, leading to the refinement of categories and themes. Preliminary findings were presented at reflection seminars, which functioned as an additional form of analytic validation by allowing participants to critically discuss and elaborate on the researchers' interpretations.
In a final analytic step, the two interview-based analyses were re-analysed together with observational data, documents and seminar notes. At this stage, enablers and constraints were interpreted as learning conditions in light of the theoretical framework. Collaboration emerged as a core integrative theme across data sources. Trustworthiness was strengthened through researcher triangulation, prolonged engagement in the field, and continuous dialogue between empirical material, theory and participant feedback.

Research setting

This section shortly describes the Swedish municipal context and thereafter the municipality and workplace innovation process in focus of the study.

Municipalities are self-governed through an elected assembly, which employs a municipality director with chief executive power. The municipal council also appoints executive boards that govern municipal departments that hold operations such as elderly care, schools and road administration. The municipality where the studied innovation process took place had approximately 150 000 inhabitants and 13 000 employees. The innovation process took place under the executive board of Health and Care (H&C) within the department responsible for the health and care of disabled and elderly people in the municipality. H&C departments in municipalities often operate under difficult financial conditions as they tend to have budget deficits or tight budgets, paired with an increasing need of care among citizens due to an ageing population and hence increased costs. There is also a general shortage of skilled workers. Altogether these challenges effect the possibility of delivering high-quality H&C services (Fogelberg Eriksson & Halvarsson Lundkvist, 2024).

The above-mentioned challenges contributed to a general notion among central decision makers in the municipality that the approach to delivering H&C services needed to change into a new one, triggering a process of workplace innovation. The new approach to H&C (the innovation) was planned to be developed in three phases (the innovation process). The first phase, "initiation" (1,5 yrs), revolved around five interrelated and coordinated projects involving managers and staff representatives. These projects focused on developing a new model with methods and concrete working procedures for providing H&C, suggestions for changes in organisation and staffing, suggestions for change of competence profiles for recruitment and competence development, suggestions for management and budget systems, as well as suggestions for development of use of welfare technology. As the projects ended, the second phase, "test and development" (1,5 years), slowly started and was supported by four designated "change leaders" from the second year of the second phase. During the second phase, the new approach was tested in a limited number of H&C operations within one geographical part of the municipality. The Covid 19-pandemic delayed

the second phase, as well as the third one, "implementation", as the new approach to H&C was rolled out in the entire H&C operations of the municipality.
The new approach that was developed was referred to as a rehabilitating working method. In municipal documents it was stressed that the new approach rested on four basic pillars: support based on the citizen's goals, working towards strengthening the citizen, the citizen as an equal party, and close cooperation between professions, the citizen and civil society. It was further emphasised that the support had to be designed so that the citizen's abilities were taken advantage of and, if possible, developed by everyone around the citizen working to strengthen them. The municipality's support to the citizen therefore had to be cohesive and coordinated throughout the citizen's care process. It was stated that this required better collaboration and interprofessional approaches in all parts of the citizen's process.

The new approach entailed a new way of thinking about and providing H&C services, which required educating both first-line managers and H&C workers and developing more rehabilitating working methods. As an example, instead of helping an elderly person to get dressed, the elderly person should receive adequate support to do so herself. The new approach not only required new working methods but also new ways of organising H&C services and new forms of collaboration between different professional workers.

Findings

This section presents the findings, structured by conditions that enabled or constrained the innovation process, as well as taking two phases of the innovation process into account: when moving from development to testing of the new approach to H&C, and when moving from test to implementation of the new approach to H&C in the operations.

The findings section revolves around collaboration, which stood out as a core theme when analysing the empirical material from all data sources. The new approach, the rehabilitating working method, depended on collaboration between professions, the citizen and civil society: A fundamental idea in the rehabilitating working method was collaboration between different professions around a citizen with care or support needs. In addition, collaboration between the line organisation (delivering H&C services to citizens) and the authority organisation (deciding on what kinds of H&C services a citizen is entitled to) was mentioned as a prerequisite for the new approach. The interview responses showed that the new approach not only required collaboration between all professions based on the needs of the citizen, but also collaboration higher up in the organisational hierarchy to facilitate collaboration between the professions.

But collaboration within units and activities and between them also emerged as a fundamental condition for the innovation process (cf. Torfing et al, 2020), in the development, testing and adoption of the new H&C approach. It was evident that collaboration was needed to be able to learn about, develop, test and implement the new approach. This included

collaboration among and between actors both within and outside the H&C department, i.e. different professionals and workers with different responsibilities vis-a-vis the citizen in need of H&C services.

Conditions that enabled the innovation process

Two constitutive conditions enabled collaboration and learning during the initial, developmental and testing phases of the innovation process. One condition was the *long-term commitment of politicians* and their long-term decisions that made it possible to start and sustain the innovation process. Another condition was that *the organisational innovation process was led and coordinated by a project leader* (a central-level change strategist), who had the mandate to get "the right people" together and offer arenas for generation and development of the new approach to H&C. The five initial projects were such examples of arenas where a selection of managers and employees jointly developed the new approach. The project leader also had an important role in developing consensus between the central H&C department and the local operations (H&C units) of the municipality during the initial phases of the innovation process.

In addition to these constitutive conditions, a condition that was put forward as generally enabling for all phases of the innovation process was having a *committed unit manager,* who for example showed interest in, prioritized and allowed employees to partake in the development or testing of the organisational innovation. Everyone taking part in interviews and reflection seminars emphasized the crucial importance of the unit manager for the development and implementation of the new approach.

As the innovation process moved from development into testing of the new approach at a selected number of the operational units, there were other types of conditions that were forwarded as important enablers of the innovation process and the collaboration between professions around the citizen. The designated *change leaders* that facilitated workshops and supported operations during the development and test phase were clearly emphasised as conducive for the innovation process by all participants. The change leaders functioned as concrete support in the units, exemplified in interview excerpts such as these: "It makes it easier as the change leaders structure the cross-professional meetings.", "It is good to have two change leaders who go out to the work groups, this helps with continuity and makes it easier to learn from each other.", "...it wasn't until these change leaders were appointed, and there was a group that started working on this and could steer it, that things became more action oriented."

The change leaders seemed to function as a hub for two types of collaboration when change leaders and the professions collaborated. First, they jointly developed tools and work models that were intended to be used in the future, and second, they initially worked jointly with the care plan for the citizen. It was clear that the change leaders supported both the process of developing methods and tools and the process around the citizen. However, the interviews

did not provide a clear answer to what extent unit managers and change leaders collaborated to support the working group that worked with the citizen on a daily basis.

Organising the staff in teams around a few citizens worked as an enabling condition for collaboration and learning in the testing of the new approach to H&C. Working in interprofessional teams was a new experience particularly for the care workers within so called home care. This type of care service – the most common in Sweden – involves care workers attending to individuals' needs in their private homes. It is typically carried out as solitary work, with limited daily interaction with colleagues or other professionals, in contrast to care work conducted in specialised housing.

Conditions that constrained the innovation process

Several conditions that made the innovation process difficult or slowed it down were put forward in interviews, meetings and workshops. These conditions operated as barriers to the collaborative development and implementation of the new approach to H&C. A main finding was that barriers that constrained the innovation process varied in strength during the innovation process: Some conditions were stable barriers in all phases of the innovation process, while other barriers emerged and reproduced in a domino-effect-manner, particularly in the implementation phase. Another main finding was that the conditions that constrained the innovation process exceeded the number of enabling conditions. Since the constraining conditions were manifold they will be presented under sub-headings.

Organisational structure and operational logics and cultures

Several conditions were related to the public organisational setting and its inherent complexity and differing operational logics and cultures. These interrelated conditions were presented as barriers through the entire innovation process, but with an emerging importance and special emphasis of their particularly constraining function as the units were to implement the new approach in their operations.

In the development and testing phase as well as in the implementation phase, the municipal organisational structure presented itself as consisting of *organisational silos*, or self-contained operations with their own operational, professional and financial borders. The participation of different professional and care workers that were to gather as a team around the citizen according to the new H&C approach was constrained by the formal borders of the organisational structure and the access of competent and available staff in each 'silo'.

The different organisational silos point to the considerable *organisational complexity* that municipal organisations substantiate. The silos did not only denote horizontal compartmentalization of municipal activities, but they also came with their own organisational hierarchies. Participants related that in order to navigate the innovation process, different departments and different hierarchical and managerial levels of the municipality and care operations needed to collaborate, particularly in the innovation implementation phase. It

turned out that, in the innovation process, one measure that seemingly related to primarily one operation or part of the citizen's care process in turn affected several others in the municipal system. Thereto, the citizen's care processes – and thereby the innovation process – included collaboration with external actors such as regional health care operations (e.g. regional health care centres, hospitals). The complexity operated as an inertia to the innovation process, since several operations and managerial levels needed to collaborate in order to implement the new approach to H&C, and this was difficult to bring about.

With the organisational complexity of public organisation sector responsibilities followed *competing goals, logics and cultures* in the municipal H&C. An example that was put forward by several participants, independent of each other, of existing competing operational logics on the workplace level was the work culture among some professional groups, which was centred around helping or serving the citizen, as a 'care servant'. This collided with the logic of the new approach to H&C, which instead focused on supporting the citizen to stay independent from concrete help or service. To that, different professions had their accustomed routines, processes and their own practice, which were partly governed by different laws and guidelines, for example relating to health care, social care or the municipal control system. This constrained the actual collaboration around the citizen's needs, and this made it more difficult to find common ground. Other examples of the varying rationales for professional groups with different organisational responsibilities were put forward: When an administrator working with aid assessment decides on what amount and type of municipal H&C services a citizen is entitled to, this is an exercise of authority steered by the logic of legal correctness and the municipal obligation to fulfil equal rights to its citizens. When care workers perform or deliver care service, this follows a logic of care and of adapting to the individual and her specific care needs. When a unit manager, responsible for keeping the budget in order, decides on how to organise work at the unit the logic is rather steered by the goal of lowering costs or keeping the budget in balance. Hence, a common goal of efficiency in the municipal H&C setting could either be understood as 'legally correct decisions', 'following the goals of the citizen', or 'cost containment'. These different logics acted as barriers in the innovation process, and these became more and more apparent as the innovation process proceeded.

Budgets, funding and administrative systems

The constraining condition of organisational silos co-varied with the *different budgets* that employees of different units belonged to. This conditioned employee participation and activities, relating to both the innovation process and the new approach to H&C. The strained budgets and the general economic situation operated as constraints for participating in development and learning activities, as fill-ins had to be appointed, bringing double costs to the unit, if staff were to participate in the innovation process. The compensation calculations according to the remuneration systems, regulating the operations that collaborated in the innovation processes turned out as structural obstacles for developing the new approach and in some instances seemed to counteract the implementation of the new approach. Some private H&C companies (private contractors) delivered H&C services on behalf of the

municipality, and these companies were compensated by invoicing the municipality for their services. An inherent idea of the new approach was to reduce costs if citizens could become more independent and in need of less hours of care. According to the participants such a situation was not favoured by the private companies, that instead were interested in invoicing the municipality as many hours of delivered care as possible.

As is common in other Swedish municipal H&C operations, the operations that participated in the studied innovation process used a large number of digital administrative systems, often daily. These were used for example to document aid assessment, care needs and plans for care, delivery of care service, reporting of critical incidents, administrating personnel and staffing, budget systems, invoicing – to mention some of them. It was repeatedly reported that these systems were apprehended as *incongruent administrative systems*, that did not facilitate collaboration neither in the innovation process nor in the actual care work in accordance with the new approach. Multiple systems required multiple reporting, and the information required or asked for by the system did not easily form a basis for collaboration around the new H&C approach. Instead, managing the administrative systems required considerable effort, but this did not support the innovation process nor the new approach to H&C. In addition, the procurement of IT systems that were ongoing during data collection could not support the innovation process, towards the new H&C approach. The procurement became a lengthy and complicated process and the absence of a cohesive and adequate IT system to support the new approach slowed down the innovation process.

Availability of adequate resources

A stable barrier through the entire innovation process was the *lack of continuity of staff and managers*, and this related to all organisational levels of the municipal H&C. Several of the initiators of the innovation process were no longer there as the process continued towards implementation. This applied to both politicians and civil servants, something which necessitated constant anchoring work by the project leader (and change leaders) and re-starts that consumed resources that otherwise could have been allocated to developmental or implementation work. In the testing and implementation phases, it was noted that some professionals came unprepared to team meetings and were not informed about the citizen in need of care. The citizen's contact person was not always present at meetings, and different people around the same citizen could appear at different meeting times. This all related to the staffing situation, for example staff shortages, organisation of home H&C and scheduling. The assistance officers (administrators) did not work continuously around the same citizen, and to that could sometimes follow old guidelines (those prior to the new approach) when assessing the aid and care needs of the citizen. Managers that were employed during the innovation process were not always informed about the new approach to H&C, and they therefore lacked both knowledge of and interest in implementation of the new approach. Altogether, the lack of continuity of staff and managers was a condition that constrained the collaboration and slowed down the innovation process, particularly in the implementation phase.

Another stable barrier through the entire innovation process was the general *lack of time*. Collaboration was limited by the ability to allocate time for participating in meetings, meeting times were generally considered too short to actually discuss and decide upon the citizen's care needs in relation to the new H&C approach, and managers were pressed by other issues and could not allocate time to participate where they would have needed in the innovation process. Not only daily operations, but also multiple and parallel organisational change processes, were competing for time.

In the implementation phase, the project leader and the change leaders ascertained that the *change leaders lacked mandate*. The changes leaders were considered as important facilitators of the early stages of the innovation process, particularly in assisting units and interprofessional teams in their learning, testing and incorporation of the new H&C approach. In this phase, their role was clear, and they could both support and push units and teams to test the new approach. However, as the implementation phase was rolled out, and the responsibility for implementing the new approach was laid on unit managers, the change leaders' mandate to influence and support the innovation process diminished. The level of engagement of each unit manager varied in the implementation phase, and participants pointed out that the engagement for adopting the new approach in some cases was low. Altogether, this constrained collaboration around and implementation of the innovation.

Figure 1 attempts to visualise a selection of the most salient barriers mentioned above, and their emerging character, to the innovation process. The barriers became conditions that constrained learning and transformative action, and therefore also the innovation process and they became more salient during the transition from test to implementation. The figure also visualises that the conditions interacted in a complex web where one barrier in turn reproduced into other barriers, not only in a linear and causational way, but rather dynamically interconnected. Workplace cultures, the mandate of change leaders and the interest and engagement of managers to implement the new approach influenced the actions that participants took – or not – in relation to the adoption of the new approach to H&C. One example from the figure is that the compensation calculations (i.e. how to calculate care costs) formed a barrier to adopting the new approach since the new calculations collided with the prevalent ones, and the new calculations were in turn at odds with the municipal, organisational silo, budgets. These in turn collided with different operational logics and the municipal control system, creating barriers to the adoption of the new approach in the H&C operations.

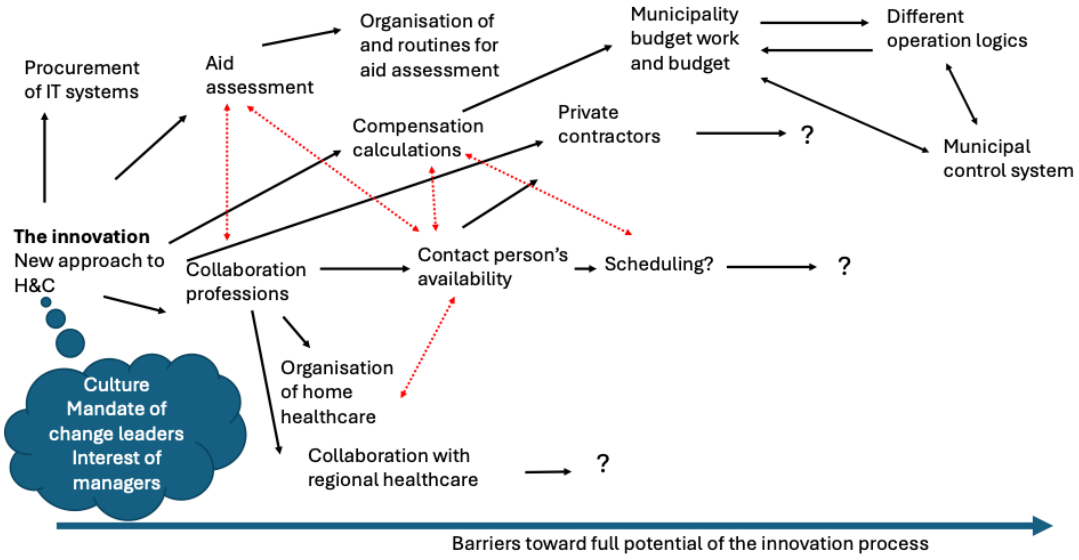

Figure 1. Examples of emerging barriers that slowed down the implementation of the new approach to H&C.

The figure further depicts how the innovation, that is, the new approach to H&C, during the course of the innovation process first affected collaboration between professions, procurement of IT systems, and aid assessment. It also directly affected compensation calculations and private contractors. But it did not stop there. In turn, as shown in figure 1 by arrows, various secondary barriers occurred as a result of the initial barriers, in respective context. The red, dotted, arrows, illustrate that the secondary barriers related to other barriers in other contexts. The question marks in figure 1 indicate that particpipants found it likely that new barriers will occur, for example when new schedules are launched.

Discussion

The findings showed that the conditions that enabled learning and facilitated collaboration in the innovation process primarily related to the initial stages of the process, when developing and testing the new approach to H&C (Lidman, 2023; Nählinder & Fogelberg Eriksson, 2017). In the development and testing phases of the innovation process, support from change leaders and managers, arenas for collaboration and teamwork and access to learning activities, such as workshops, were offered to employees and managers (Deutscher & Braunstein, 2023; Fuller & Unwin, 2011). This allowed participants to collaborate, experiment, develop and explore the new approach to H&C (Ellström, 2006) which indicates an expansive learning environment (Fuller & Unwin, 2004) in the early phases of the innovation process (cf. Rosing et al, 2011; Criado et al, 2025).

Despite enabling conditions for learning in the development and testing phase of the innovation process, the barriers that emerged as particularly strong in the implementation phase slowed down further collaboration and the actual adoption of the new approach to H&C (Evans et al., 2011), and thus also hampered the innovation process (Halvarsson

Lundkvist & Gustavsson, 2018; Lidman et al., 2023). The mutual engagement in innovation activities involved negotiations of meaning (Fuller et al., 2005), but the different work cultures did not always function as promotors of transformation towards the new H&C approach in the implementation phase (Engeström, 2001; Engeström & Sannino, 2021). The collaboration and learning in various groups in the initial and test phases of the innovation process could not be sustained in the implementation phase because of emerging barriers in other operations, including lack of interest from unit managers and a shortage of time.

The findings showed that there were indeed both stable and emerging barriers that constrained learning in the innovation process (Fuller & Unwin, 2004; 2011). The barriers were formed in a complex pattern of domino-effects raising through overhead departments and administration systems (Lam, 2005). Although many of them related to the ones previously depicted as innovation barriers in the public sector context (Cinar et al, 2019; Lidman, 2023), these barriers could not fully be foreseen by the participants when the innovation process started and most of them emerged and grew stronger in the shift from the generation phase to adoption. The case thus showed that the H&C operation was able to develop and test the new idea but found it difficult to implement the innovation throughout the organisation and thus benefit from its potential good value (Damanpour, 2020). In order for the new approach to H&C to be fully implemented, the emerging barriers would have needed to be addressed, triggering changes in other than the H&C operations. Collaboration at higher hierarchical municipality levels, to lessen the impact of the emerging barriers, had not been prepared for.

In this sense, the studied municipal innovation process is not unique. The municipality at hand shared the same concerns as many other Swedish municipalities that initiate a workplace innovation process, regardless of whether it is called a development project, development work, improvement work or something else (Wihlman, 2014). The lack of sustainability in the innovation process is often due to the fact that the other components in the complex system cannot receive or support what is 'ready' to be implemented (Lidman, 2023). Added to this is the realisation that every implementation requires a local workplace innovation process where also adopters need opportunities for learning and moving away from existing work methods, towards new ones (Ellström, 2010; Engeström, 2001; Engeström & Sannino, 2010). This expands the view of adopting an innovation as mere exploitation (cf. Rosing et al, 2011). The local innovation process, in turn, demands unit managers to work development oriented (Ellström, 2010). However, municipal unit managers often lack resources to prioritise innovation, particularly in the implementation phase (Lidman et al, 2022).

Conclusion

This paper set out to explore conditions that enable and constrain workplace innovation in public sector organisations, with particular attention to how such conditions unfold across different phases of an innovation process. Based on a longitudinal case study of workplace innovation in municipal health and care operations, the study offers several contributions.

Theoretical contributions

The paper contributes to public sector innovation research by advancing a learning-oriented and processual understanding of enabling and constraining conditions for innovation. Rather than treating barriers as static obstacles, the findings demonstrate how conditions emerge, interact and intensify over time, particularly during the transition from development and testing to implementation. By integrating concepts from workplace learning theory, the study shows how both stable and emerging learning conditions shape the sustainability of workplace innovation processes.

Practical and managerial implications

For practitioners and managers in public organisations, the findings highlight that conditions that support collaboration and learning must be actively sustained beyond the early phases of innovation. While arenas for experimentation and dialogue supported development and testing, the lack of equivalent learning support during implementation constrained adoption. Unit managers play a crucial role in creating learning conditions, underscoring the importance of managerial capacity and mandate to prioritise developmental work throughout the innovation process.

Implications for governance and policy

At a governance level, the study suggests that successful workplace innovation in public organisations requires coordination across organisational silos, budget systems and administrative infrastructures. Anticipating emerging constraints during implementation calls for governance arrangements that enable cross-level collaboration and alignment of control systems, funding models and digital infrastructures with innovation goals.

Finally, as this study is limited to a single municipal case, future research would benefit from comparative and longitudinal studies examining how emerging learning conditions influence innovation outcomes across different public-sector contexts.

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Discussion Forum

The Challenge of Socio-Technical Work Design

An Essay on the Open Issues of Industry 4.0 and Industry 5.0

Hartmut Hirsch-Kreinsen

Abstract

This essay examines the challenges of socio-technical work design in the current phase of economic and industrial transformation. It demonstrates how these challenges are approached differently within the Industry 4.0 and Industry 5.0 concepts. Despite these divergences, it is argued that both visions draw on the socio-technical systems approach to designing human-centred work. The starting point is the principle of joint optimisation of the socio-technical approach, whereby the interfaces between the technology, human and organisational sub-systems can be considered the central design options. However, from a sociological point of view, the socio-technical systems approach is criticised for being overly voluntaristic. This is because it focuses solely on the micro-level of work process. It overlooks structural conditions of work that extend beyond this and have a lasting influence on the socio-technical design of work. It is particularly evident in the context of the current phase of crisis and industrial transformation.

Finally, prospects for the debate on socio-technical work design and human-centred work, as well as the broader concepts of Industry 4.0 and 5.0, are considered in the context of industrial transformation. It is presumed that the future of this discussion, particularly regarding human-centred work design, as well as the concepts of Industry 4.0 and 5.0 in general, is characterised by significant uncertainty. Given the crisis-level challenges of the industrial transformation, it is assumed that the debate on human-centred work and the concepts of Industry 4.0 and Industry 5.0 will lose their current political relevance.

Keywords: Work design, socio-technical system, Industry 4.0, Industry 5.0, human-centred work

The Essential Resource: Work

In the EU, and particularly in Germany, the industrial sector is under sustained pressure to change. Under the banner of industrial transformation, the challenges of inevitable change and the search for appropriate solutions are becoming the focus of public, political and scientific debates. There is no question that coping with industrial transformation is a complex social and economic problem. On the one hand, there is an on-going discussion about changes to the institutional conditions of the production and innovation system. In particular, increased institutional flexibility and agility, as well as new forms of policy and regulatory patterns, are considered indispensable (Edler & Walz, 2024). On the other hand, this affects individual companies, where fundamental strategic and cultural change is usually accompanied by technological, organisational and personnel reorientation and design concepts. In many cases, such as in the automotive industry and its suppliers, this cannot be limited to the iterative and path-dependent transformation processes that have been practised and proven successful to date (Hirsch-Kreinsen, 2020). Instead, disruptive leaps in terms of technologies, innovations or business models are inevitable if companies are to secure their long-term existence (Krzywdzinski, 2022).

A broad spectrum of very different approaches and concepts in terms of industrial policy, innovation policy and corporate policy have been proposed in response to this pressure for transformation (Amaroso et al., 2022; Dullien & Hackenbroich, 2022). At the macroeconomic level, policy measures in the areas of trade, energy, and education are being discussed to initiate and facilitate the transformation process in companies. Additionally, the focus is on new innovation strategies and corporate policy concepts for transformation.

In this context, the question of the future role of work is of great importance. Despite the need for a broad perspective on the challenges of industrial transformation, it has been emphasised that work is a vital resource for this process. The collective intelligence of the workforce has always been considered an indispensable prerequisite for successfully adapting to change and new requirements. This has been clearly demonstrated by numerous studies on the digitisation of industrial work in particular. Furthermore, social science research has consistently demonstrated that the experience, implicit knowledge, and skills of employees are crucial for successfully managing innovation and change (Hirsch-Kreinsen & Ittermann, 2021).

Therefore, the question of how industrial work should be structured in the future to cope with change is of vital importance in the discourse on transformation. This will be examined in more detail below. The focus is on the modernisation concepts Industry 4.0 and Industry 5.0. These concepts have been extremely prominent in innovation policy and practical application with regard to industrial transformation in Germany, Europe, and far beyond for years. Both address the topic of the future of work, albeit in different ways. Nevertheless, both visions are based on the socio-technical systems approach to designing human-centred work. However, the main argument is that, from a sociological point of view, the socio-technical systems approach is overly voluntaristic. It overlooks the structural conditions of work that

extend beyond this and have a lasting influence on socio-technical design. This is particularly evident in the context of the current phase of industrial transformation.
These arguments will not be discussed in detail within the context of a systematic research paper. Instead, the paper has the character of a critical, sociologically informed essay on the socio-technical foundations of work design within the context of Industry 4.0 and 5.0. Therefore, the paper only selectively refers on relevant literature from the fields of labour policy, the sociology of work, and the theoretical field. Additionally, the arguments draw on the author's long-standing involvement in the political and academic discourse on Industry 4.0 and 5.0, and on his experiences and knowledge gained through this involvement.

Different Understanding of Work Design

Industry 4.0 is a German initiative that was launched in 2011. In 2021, ten years after the introduction of Industry 4.0, the European Commission announced Industry 5.0. A fundamental difference between the two concepts can be seen in the fact that Industry 4.0 is technology-oriented, whereas Industry 5.0 is value-oriented (Xu et al., 2021; Fogaca et al., 2025). However, a more detailed analysis is required to clarify this distinction. This is particularly relevant when considering the significance of work within each concept and the design criteria under discussion.

Industry 4.0

Since 2011, the Industry 4.0 concept has received a great response both nationally in Germany and internationally. Many countries have introduced similar strategic initiatives, and considerable research has gone into developing and implementing some Industry 4.0 technologies. As its founders emphasise, the concept's goal was to strengthen the resilience and competitiveness of the German economy by improving adaptability and resource efficiency in response to the global financial crisis. In other words, the aim is to modernise industry by widely using digital technologies (Kagermann et al., 2011; Vogel-Heuser & Hess, 2016). This encompasses leveraging current trends such as industrial AI, edge computing, edge cloud, 5G in factories, team robotics, autonomous intralogistics systems and trustworthy data infrastructures (Kagermann & Wahlster, 2022).

Although the Industry 4.0 concept is a politically supported initiative of the German Federal Government, it was developed and launched by politically influential academics and business representatives (Kagermann et al., 2012). Those involved came from the fields of computer science and engineering, as well as from companies in the electrical, mechanical engineering, automotive and software industries. At the same time, the further development of the concept, the drafting of a research agenda and innovation policy measures, as well as its dissemination, were closely integrated into the corporatist German economic system. Consequently, the Industry 4.0 discourse and the development process took place within a framework of cooperation between politics, business, academia, trade associations and, above all, the influential metalworkers' union.

This had consequences: Firstly, despite the scepticism of many company representatives, the concept was quickly translated into a large number of concrete applications within companies (Forschungsbeirat & acatech, 2022). Secondly, in terms of innovation policy, the topic of work design was relevant from the outset despite the strong focus on computer science and engineering in the Industry 4.0 discourse. Questions about the quantitative and qualitative consequences of work, and in particular the potential for human-centred work design offered by new digital technologies, were intensively discussed in the context of Industry 4.0.

Furthermore, this discourse indirectly placed the topic of the future of work on the research policy agenda in Germany and on the agenda of a wide range of labour- and industrial policy activities. In other words, Industry 4.0 provided lasting impetus for social science research on work and the debate on criteria for human-centred digital work design (see e.g. Hirsch-Kreinsen, 2023 for a summary). Therefore, the Industry 4.0 concept cannot be said to be predominantly technology-centric (Howaldt et al., 2017). Rather, work is considered an indispensable element of a digitised production process in this discourse (Kagermann et al., 2012). Accordingly, fundamental design criteria and potential applications for digital industrial work have been developed during the Industry 4.0 discourse. These are based on well-known human-centred work guidelines, such as autonomy and self-determination, teamwork and flexibility, continuing education and participation, and decentralisation and flat hierarchies (Forschungsbeirat & acatech, 2024).

In summary, Industry 4.0 recognises digital technologies as the starting point and driving force for overcoming the challenges of industrial transformation. According to recent thinking, technology should be used not only to achieve economic goals, but also broader socio-political ones. For instance, social objectives such as autonomy, interoperability and sustainability are emphasised (BMWI, 2020). Work is considered an indispensable element of successful digitisation and overcoming the challenges of industrial transformation. Therefore, in the concept of Industry 4.0 work can be regarded as a loosely coupled dependent variable of digitisation.

Industry 5.0

As complementary to Industry 4.0, the EU Commission presented the concept of Industry 5.0 in 2021. This concept is based on the idea that economic and technological objectives should be aligned with social and environmental objectives (European Commission, 2024). Some authors note that the conceptual roots of Industry 5.0 can be traced back to Japan's Society 5.0, which focuses on societal transformation beyond manufacturing efficiency (Genest, 2025). Consequently, Industry 5.0 can be considered a concept with a strong political and normative foundation. It is characterised as a top-down initiative in response to the changing societal, environmental, and geopolitical landscape. Its general goal is to expand the Industry 4.0 concept, considered technology-centric and overly economically oriented, by placing

social, political, and ecological goals at the starting point of discourse and development, rather than technology (Xu et al., 2021; Banholzer, 2022).

The concept states that digital innovation and its application in the form of services, products and processes must ensure threefold goals of being sustainability, human-centricity and resilience with regard to industry, the economy, society and its citizens and members (Oeij & Dhondt, 2026). However, these objectives are as broad as unspecific: human-centricity, sustainability, and resilience should be promoted within company frameworks, while the work and production processes of companies should contribute to solving societal problems rather than primarily serving the interests of shareholders. Against this background, the concept of Industry 5.0 is understood as a multidimensional innovation ecosystem that can contribute to the humanisation of working life and the democratisation of socio-ecological transformation (Kopp & Schröder, 2024).

As far as can be ascertained, companies have been very limited in their involvement in the Industry 5.0 discourse to date, and it is unclear to what extent it has spread across the various EU countries. While the literature emphasises that the goals of Industry 5.0 have gained broad political acceptance, its diffusion and practical adoption may be still in its early stages. As far as the situation can be assessed, it is currently being discussed at a general European level, with political actors, social scientists, and, to some extent, European umbrella organisations of employers' associations and unions, playing an active role. In particular, academia has quickly embraced discussions on Industry 5.0, highlighting its relevance (Xu et al., 2021). Research indicates that the current development phase of the concept is centred on establishing the basis for circular and cross-sectoral practices (Barata & Kayser, 2023). Furthermore, national governments' and industries' response to Industry 5.0 is currently limited. This is particularly true in Germany, where the Industry 5.0 concept is viewed critically as an unnecessary competition for Industry 4.0 (Forschungsbeirat & acatech, 2024a).

Focusing on the work issue, the level of analysis and conception remains relatively unspecific at a meso level across different employee groups beyond the shop floor and manufacturing. However, there is an ongoing discussion about concrete approaches in the context of Industry 5.0 (Oeij et al., 2024; Oeij & Dhondt, 2026).

In summary, unlike Industry 4.0, Industry 5.0 takes human-centred work as the starting point for designing work processes. The use of technology must be fundamentally oriented towards this criterion. At the same time, it is hypothesised that this will also facilitate the achievement of broader social goals such as sustainability and resilience. In contrast to Industry 4.0, Industry 5.0 can be characterised by the fact that the normative provisions of human-centred work act as the independent variable and technologies as the dependent variable.

The Socio-Technical Design Perspective

Clearly, the two approaches conceptualise the importance of work differently. Nevertheless, there are also clear parallels in terms of how work design can be approached conceptually. This is because both concepts refer to the well-known socio-technical systems analysis and design approach. This provides an important point of reference, in the context of the Industry 4.0 debate (Kagermann et al., 2012), as well as in the current Industry 5.0 discourse (Oeij et al., 2025; Oeij & Dhondt, 2026).

On the Approach

Research on the approach has not always been consistent in its definitions of a socio-technical system, and different approaches exist in Scandinavia, the Netherlands, Belgium, the Anglo-American region and German-speaking countries (de Sitter et al., 1997; Kuipers et al., 2020; Bendel & Latniak, 2023; Oeij et al., 2025). Without going into detail about these differences here, the following general characteristics can be identified based on the Tavistock approach (Trist & Bamforth, 1951; Rice, 1963): A socio-technical system can be understood as a production unit consisting of interdependent technological, personnel, and organisational subsystems. Although the technological subsystem can limit the design possibilities of the other two subsystems, the latter display independent social and psychological characteristics that, in turn, affect the functioning of the technological subsystem. The technological subsystem includes new digital technologies; the human subsystem refers to employment structures and skill requirements; and the organisational subsystem comprises workplace structures, new management functions, and company business models. The technological subsystem can limit the design possibilities of the other two subsystems; these display independent social and psychological characteristics that affect the functioning of the technological subsystem. In the socio-technical approach, the focus is not on technology or work per se, but rather on the complementary design of the three subsystems, which are adjusted to one another within a total socio-technical system (Trist & Bamforth, 1951). In other words, the specific strengths and weaknesses of technology and human work must be considered equally to meet the demands of production. Furthermore, it is important to note that the socio-technical system is embedded in strategic and normative framework conditions and societal context factors, such as politically established regulations.

The basic principle of the socio-technical systems approach is the *joint optimisation of work, organisation, and technology* (Cherns, 1987). The intention is to achieve two goals that are usually pursued independently of each other: On the one hand, human-centred work which is essentially based on normative and labour policy considerations. On the other hand, it is expected that efficiency and productivity will increase as a result of better working conditions. In other words, the main goal of this approach is to implement forms of digital work that are both efficient and people-centered (e.g. less stress, alienation or degradation), greater participation and more motivated employees (Grote & Guest, 2017; Bendel & Latniak, 2023).

Design Options

Design criteria based on these considerations can be systematically derived for designing and implementing human-oriented forms of digitised work. Following the principle of joint optimisation, the design criteria should focus on the *interdependencies between technology, personnel, and organisation* rather than on a single subsystem. Therefore, the focus should be on designing the interfaces between the technological, human, and organisational subsystems of the entire socio-technical system (Hirsch-Kreinsen, 2023; Oeij & Dhondt, 2026). Referring to considerations from the sociology of work, which are loosely linked to the Industry 4.0 discourse and the socio-technical approach in general, the following design options for these interfaces can be identified (Kadir & Broberg, 2020; Hirsch-Kreinsen & Ittermann, 2021; Hirsch-Kreinsen, 2023):

Technology–Human Interface

The design of the interface between the technological and personnel subsystems is, of course, a matter of considering the well-known criteria of ergonomically oriented dialogue design. However, interaction between machines and human work means more than that. Intelligent digital systems allow new patterns of function distribution and interaction between machine and human to be designed. Important are two basic alternative solutions for designing the technology-human interface: First, digital systems can provide strict instructions to workers to limit their scope of action and reduce qualification requirements. This solution can be termed *technology-centred.* Secondly, digital systems can be used as *assistance systems* that support workers, allow a variety of work, promote on-the-job learning processes, and thereby raise qualification levels. From a human-centred perspective, the second design solution is clearly preferable due to the criterion of human-centred work. This solution should be based on design criteria such as

Context sensitivity and adaptivity: these criteria include aspects of the ergonomic adaptation of digital systems to specific loads and working conditions. Adaptivity means tailoring information and support systems to workers' varying levels of competence to ensure continued learning and enhanced processes at staff level.

Complementarity: this criterion focuses on the flexible and situation-specific allocation of functions between humans and digital systems, as well as ensuring the system is sufficiently transparent and controllable. Concerning AI-based systems, these requirements can be summarised by the concept of *Explainable Artificial Intelligence* (Mihály, 2023).

Additionally, human oriented interface design is a prerequisite for satisfactory functional and economic capability of the total system. This requires a holistic view of human-machine interaction and the identification of the strengths and weaknesses of both human work and digital technologies.

Human–Organisation Interface

The human–organisation interface deals with changes in scope for action, working time models and new demands on skills, qualifications and modes of training. From a human-centred perspective, the human-organisation interface can be designed to sustainably revalue activities and skills. There are options for efficient patterns of work organisation, as well as work situations with particular qualification demands, a high degree of scope for action, the polyvalent deployment of workers and a multitude of opportunities for learning on the job, where skills and competences can be acquired independently. Both individual and collective learning can take place through job rotation, as well as through *learning islands or learning factories* (Abele et al., 2018). Learning-promotive work organisation and training measures should take into account the various levels of experience and skills of employees. Additionally, tasks will rarely address individual workers, but rather teams. This means that 'work collectives' should be able to act in a self-organising way and be highly flexible in addressing the problems to be solved in the technological system.

The main criteria for designing work activities at the human-organisational interface can be summarised by the *concept of holism*. Firstly, an activity should include not only executive tasks, but also dispositive tasks such as organising, planning and controlling. Secondly, this criterion aims to achieve an appropriate, stress-reducing mix of more or less demanding tasks. Holistic activities are therefore the central prerequisite for a high degree of freedom of action and self-organisation of work. Ultimately, this also creates the organisational conditions for continuous learning and qualification processes.

Organisation-Technology Interface

At the organisation-technology interface, redesigning the work organisation and even the reorganisation of the whole company creates new design options. Changes to the production chain in terms of function and hierarchy are possible, e.g. structuring and linking the direct processes with the indirect planning, engineering, management, and support processes. A main prerequisite is that the new digital systems allow a significant departure from the centralised IT systems of previous years due to their decentralised and simultaneous networked intelligence. Consequently, a general shift towards *decentralisation* is possible.
This affects not only the manufacturing process, but also the hierarchical dimension of the entire company organisation and logistics. Features of social media, and the new forms of communication they bring, also affect indirect areas such as planning, control and engineering, as well as leadership and management functions. Additionally, management functions in manufacturing and business divisions must be reorganised due to changes in their decision-making power and the transfer of responsibilities to subordinates (Kopp et al., 2022).

Critique and Open Issues

The socio-technical systems approach is highly valued for its analytical and design-oriented nature. This is because it provides a conceptual basis for systematically determining alternatives and options for designing work processes in a specific operational situation. Additionally, the approach provides a basis for a shared understanding among the divergent interest groups involved in system and work design, including management, employees, and their representatives. This is because the functional relationships it describes, and its fundamental premise that work-oriented system design is a prerequisite for economical production, provide a basis for reconciling diverging interests in the process of work design.
From a sociological perspective, however, the socio-technical systems approach and the design principles based on it can be seen as *overly simplistic or even voluntaristic*. This is because it focuses primarily on the analysis and design of the immediate work process. Structural and societal factors and conditions that extend beyond this and which have a lasting influence on the socio-technical design of work are excluded. The following arguments should be highlighted here:

Hybrid Systems

The approach is rooted in a conventional, static technical-organisational perspective on work situations. Technology is understood in a one-dimensional way as automation technology, and the technical and social subsystems are viewed as interdependent, but only loosely coupled. The approach pays little attention to the technical and organisational characteristics of new digital and smart technologies. Research has long pointed out that, in the context of the increasing use of smart digital systems, the technological and work dimensions should be understood as a closely and dynamically linked functional unit (Leonardi, 2012; Winter et al., 2014). The interaction between intelligent systems and worker behaviour has generally to be described as *hybrid*. This means that the relationship between technology and humans in terms of tasks and actions is constantly redefined depending on the situation. A typical example of this is the dynamic and only situation-specific interaction between AI systems and work. It can therefore be concluded that only a hybrid perspective encompassing both technology and humans can reveal the distribution of activities and degrees of autonomy in socio-technical constellations (Schulz-Schäffer, 2025).

Dynamic Change

Due to its primary focus on the container of internal functional areas, the socio-technical approach does not systematically consider recent trends in cross-company networking (Walker et al., 2008). Firstly, there are the dynamic trends of the current digitisation phase, which can be summarised by terms such as service orientation, new business models based on big data, and the platform economy. Secondly, a company's ecosystem, including customers, suppliers and other social stakeholders must become the reference point for socio-technical work and system design. These developments require a shift away from a static understanding of the joint optimisation of technology and organisation, in favour of a

dynamic understanding of cross-company value chains and the associated adaptation and coordination processes (Winter et al., 2014).

Furthermore, the design of socio-technical work systems must be rapid and adaptable. As the tension between standardised regular operations and companies' pressure to innovate increases, work systems can no longer be set up once and for all; they must be able to adapt quickly to changing conditions. Further developments and versions, *learning by using*, must therefore be incorporated into the socio-technical concept and design from the outset (Bender & Latniak, 2023).

Different Sectoral Structures

Furthermore, human-oriented socio-technical work design must always consider the working structures of different sectors. This is because design criteria must be adapted to the specific material, structural and functional characteristics of different process types and work segments in terms of requirements and qualifications (Krzywdzinski, 2022). These characteristics present different obstacles or opportunities not only for the layout of digital systems, but also for socio-technical work design. This thesis follows the prevailing wisdom of sociological studies of work, which have demonstrated significant technical, organisational, and work-related differences between different industries and work segments in terms of rationalisation processes and work design (Schumann & Kern, 2023). In manufacturing, for example, these differences can be seen when comparing low-skilled jobs in standardised logistics processes with skilled assembly work in manufacturing industries and complex monitoring activities in process industries. These refer to completely different process logics, technological possibilities, development perspectives and work patterns. Therefore, the design of the aforementioned interfaces between the three socio-technical subsystems depends on the structural framework conditions of different work segments and industrial sectors.

These divergent conditions lead to in different socio-technical design options and requirements for work. Consequently, there is no uniform approach to human-centred work design. Rather, one must speak of different development perspectives in different sectors and work segments for human-centred work.

Societal Conditions

Additionally, societal framework conditions are not sufficiently taken into account. Conceptually, it is assumed that a socio-technical system is always linked to overarching structural factors (Rice, 1963). However, it remains unclear what consequences this has for work design strategies. For example, it is an open question whether socio-technical work design always leads to improved process efficiency. Research findings show that human-oriented work design has positive economic effects, but only in the long term. In the short term, however, they are often associated with costs and risks that are difficult to quantify, and which deters companies from taking such measures. Therefore, companies are often only

minimally interested in forward-looking HR strategies due to cost considerations and limited resources. This is particularly true of the large number of SMEs with limited resources.

Also, the influence of dynamic technological development should not be overlooked; companies are under considerable pressure to innovate (ten Hompel et al., 2019). Consequently, contrary to the goal of human-oriented work design, companies are focusing solely on technological applications and relying on their employees' ability to adapt informally to new technological requirements. In this respect, the transformation of work in the context of digitalisation is characterised by a lack of innovative and human-oriented patterns of work and a high degree path dependency (Hirsch-Kreinsen, 2020).

Finally, different normative orientations with regard to desirable work patterns must be acknowledged. However, the current debate on human-oriented forms of work overlooks divergent views among different employee groups, which are associated with varying degrees of acceptance and thus possibilities for implementing such forms of work. Naturally, highly qualified employees expect good, human-oriented working conditions. In contrast, such expectations are not necessarily found among low-skilled workers e.g. in logistics. According to our own research findings, employees in this segment often prefer restrictive, routine-based and predictable working conditions that are familiar to them, as these are less stressful. Experiments with human-centred work design, such as group work, have been rejected by employees on various occasions. These divergences between different employee groups have not yet been systematically addressed in the ongoing discourse on human-centred work. Therefore, one could critically ask, in a variation on the title of an essay on the problem of "Human-centred AI" (Ahn, 2026), who is the human in human-centred work?

Uncertain Perspectives

In conclusion, the prospects of the debate and the concept of human-oriented industrial work in the context of industrial transformation will be considered. There is much to suggest that the future of this debate and the issue is unclear and uncertain. Because, recently, there have been signs that the issue of work is increasingly falling out of the focus of experts, politicians and the general public. Instead, questions about the current economic crisis, particularly how to overcome the economic and technological challenges of the industrial transformation and secure industrial locations and jobs, and a strong technological focus on AI are taking centre stage.

A clear indication of this is that in the German debate the Industry 4.0 vision and the associated work topic have clearly lost their appeal. An Industry 4.0 expert recently described the situation to the author, saying that the momentum had run out. An important reason for this is the persistent discrepancy between Industry 4.0's promises of substantial economic gains and the potential for desirable job design. The benefits are difficult to identify, and the diffusion and implementation of Industry 4.0 systems is clearly reaching its limits. Based on recent data, therefore, one can speak of a *setback* in the diffusion of Industry 4.0 in German

manufacturing in several respects. Hardly any cutting-edge applications have been implemented in recent years. In fact, there has been stagnation and even a partial decline in Industry 4.0 investments in medium and small businesses. At least, there has been an increase in advanced applications in some large companies and equipment manufacturers (Lerch et al., 2024). This setback is certainly also a consequence of the significantly changed economic challenges and location uncertainties that cannot be overcome by Industry 4.0 and digitalisation alone.

This difficult transformation situation also correlates with growing skepticism on the side of the employees and their representatives. Because of their crisis experiences many works councils view the introduction of digital technologies merely as a means of rationalization, used to replace jobs. Therefore, they often resist Industry 4.0 strategies implemented by management. Furthermore, a strategic reorientation of trade unions takes place due to pressure from production relocation and job losses. To quote a union representative, “because of the economic crisis, the hut is burning”. The consequence is a shift away from issues of human-centred technology use and work design. Institutionally spoken, this marks the beginning of the dissolution of the aforementioned typical German corporatist arrangement, of which Industry 4.0 and the work issue have been a part from the outset. This development is additionally being accelerated by a reorientation of national innovation policy towards a pronounced focus on new technological developments, especially AI and space technologies. The topic of industrial work design in industry is rarely addressed directly anymore. For some time now, this issue has been treated merely as a secondary consideration in research funding (BMFTR, 2025). And, in the social sciences field of labour research, there is also a broadening of research topics and a clear decline in interest in industry and work design issues. The field of research is becoming increasingly confusing due to the countless differentiations and positions, and many actors from the scientific community are seeking new opportunities for profiling and financing with specialised questions.

These considerations raise the question of whether the concept of Industry 5.0 and the issue of job design are in a similar situation with regard to acceptance and dissemination in the entire EU. It can first of all be assumed that the Industry 5.0 discourse and dissemination of this concept face similar problems to those encountered by Industry 4.0. Companies of all kinds need to adapt in the face of economic crises and the challenges of transformation. In particular, efficiency targets are increasingly taking precedence over the human and environmental goals of Industry 5.0 (Weckmann, 2025). Furthermore, EU-level politics will probably have to set new priorities for industrial and innovation policy, mainly due to new technological, geopolitical and geotechnological challenges (Draghi, 2024). From the outset, the Industry 5.0 concept has been linked to the EU Commission's strategic priorities, particularly the European Green Deal (Genest, 2025), but these priorities are becoming less important in politics.

Additionally, structural obstacles hinder the rapid implementation of Industry 5.0's human-centric goals. In the current difficult economic climate, the aforementioned costs and risks associated with worker-oriented design goals may have a greater impact than before, even within the context of Industry 5.0. This issue is particularly pressing for the large number of small and medium-sized enterprises that have limited or no HR resources (Barata & Kayser, 2023). Critics point out that Industry 5.0, as a value-based concept, implicitly presupposes discourse on values and willingness to bear costs. However, this is done without outlining a conception of the public sphere, political discourse or deliberative, agonistic or pragmatic debate in pluralistic democracies (Banholzer, 2022).

Another closely related issue is that Industry 5.0 must be adapted to suit the specific conditions of different countries and existing ecosystems. On the one hand, adapting the concept to different national contexts is difficult because the Industry 5.0 discourse takes place, so to speak, at a European meta-level that makes little reference to national specificities. An indication of this is that representatives of the aforementioned European umbrella organisations for both employers and trade unions are often only very loosely linked to the corresponding organisations in their home countries. On the other hand, the specific characteristics of a wide range of socio-structural factors must be taken into account. Different national institutional regulations that prevent the uniform implementation of normative standards throughout Europe must be taken into account. An instructive example of this difficult situation is that principles of human-oriented job design must be implemented within highly divergent systems of industrial relations in individual EU countries. As is well known, unlike in many other countries, work councils in German speaking countries have comparatively extensive co-determination rights with regard to job and work process design. Consequently, the human-centricity criterion of Industry 5.0 may be interpreted very differently in various EU countries, resulting in different approaches to work processes.

Hence, the visions of Industry 4.0 and 5.0, and with them the topic of human-centred work design, are expected to lose their socio-political significance as symbols of socially and socio-politically desirable progress. As with any innovation, visions are always subject to persistent application problems and uncertain outcomes that contradict and relativise such far-reaching expectations. This tension produces what innovation research refers to as the “promise requirement cycle of innovation” (van Lente, 1993). Through development activities and diffusion processes, actors gain insights into actual technological potential, as well as application challenges and risks. Over time, outcomes are assessed and expectations reformulated in a more specific and critical manner. Furthermore, the principles of decent work, employee participation and co-determination are increasingly at odds with the socio-political *zeitgeist*. Instead, top-down decision-making that is guided solely by efficiency criteria is increasingly seen as the ideal. It is therefore unsurprising that discourses on innovation concepts like Industry 4.0 and 5.0 will be not only increasingly realistic, but also sceptical and critical.

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