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A HUMAN-CENTRIC APPROACH TO TECHNOLOGICAL INTEGRATION: FROM INTERVIEWS WITH HR MANAGERS TO GUIDELINES FOR THEIR INTERVENTIONS

Teresa Galanti	G. d'Annunzio University, Chieti, Italy	teresa.galanti@unich.it
Stefania Fantinelli	Università e-Campus, Roma, Italy	stefania.fantinelli@uniecampus.it
Giulia Paganin*	Alma Mater Studiorum – University of Bologna, Bologna, Italy	giulia.paganin2@campus.unibo.it
Federico Fraboni	Alma Mater Studiorum – University of Bologna, Bologna, Italy	federico.fraboni3@unibo.it
Francesco Tommasi	University of Milan – Milano, Italy	francesco.tommasi@unimi.it
Gabriele Puzzo	Coopservice, Bologna, Italy	gabrielepuzzo01@gmail.com
Monica Molino	University of Turin, Turin, Italy	monica.molino@unito.it

* Corresponding author

ABSTRACT

Aim/Purpose — This paper addresses the need to understand how digital transformation, often framed as a technological process, is concretely translated into human resource management (HRM) practices. It examines how HR managers interpret and manage the organizational, cultural, and skill-related changes associated with digital transformation, situating these practices within the emerging Industry 5.0 landscape.

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Background	While digital transformation is widely discussed in terms of technologies and future skills, less attention has been paid to how these changes are operationalized within everyday HR practices. This study addresses this gap by exploring how HR professionals experience and implement digital transformation in recruitment, talent management, and training.
Methodology	An exploratory qualitative design was adopted. Data were collected through 14 semi-structured interviews with HR managers, consultants, founders, and innovation managers from organizations of varying sizes across Northern and Central Italy. Interviews were transcribed verbatim and analyzed using thematic analysis informed by Corbin and Strauss (2008), with coding and constant comparison conducted iteratively.
Contribution	The paper contributes empirical evidence on how human-centered models of digital transformation are enacted in HR practices. It advances understanding of HRM as a strategic mediator between technological innovation and the human experience of work, particularly within the Industry 5.0 perspective.
Findings	The findings indicate that recruitment practices are progressively moving beyond a narrow focus on technical expertise, placing greater emphasis on candidates' adaptability, learning agility, and digital mindset. At the same time, talent management is evolving toward more dynamic and flexible models that prioritize continuous learning, cross-functional collaboration, and inclusive development pathways that support fluid career trajectories. Training is increasingly understood as a strategic lever for fostering human–technology complementarity, requiring multidimensional, experiential, and personalized learning approaches that address both technical and transversal competencies. Overall, across all domains, digital transformation is not merely a technological upgrade but a broader cultural and organizational shift that reshapes roles, expectations, and ways of working.
Recommendations for Practitioners	Organizations should redesign recruitment processes to assess adaptability and learning orientation, develop talent management systems that support cross-functional mobility and continuous learning, and invest in experiential and personalized training that addresses both technical and soft skills. Leaders should foster psychological safety and support employees' adaptation to technological change.
Recommendations for Researchers	Researchers should further investigate digital transformation through multi-level and multi-actor perspectives, integrating managerial and employee experiences. There is also a need for longitudinal and comparative studies to examine how HR practices evolve alongside specific technologies.
Impact on Society	By emphasizing human-centered HR strategies, the findings highlight pathways to implementing digital transformation that support employee development, engagement, and sustainable organizational change, contributing to more inclusive and resilient workplaces.
Future Research	Future research should triangulate managerial perspectives with employee-level data, examine sectoral differences, and assess the impact of specific technologies, such as AI-enabled tools and predictive analytics, on HR practices and employee experiences.

Keywords digital transformation, human resource management, Industry 5.0, talent management, training, human-centered organization

INTRODUCTION

Digital technologies increasingly support sustainable business performance across economic, environmental, and social dimensions. Their effective use can improve resource efficiency, reduce waste, and enable circular business models (Bindeeba et al., 2025). In this vein, the first concept can be introduced, framing the following paragraphs: Industry 4.0, which is defined as industrial development characterized by the integration of cyber-physical systems (Lee et al., 2014), automation, digitalization, and advanced technologies across manufacturing and organizational processes (Culot et al., 2020). However, evidence shows that digital tools alone are not sufficient to achieve substantial environmental and operational improvements. Real benefits emerge only when digital solutions are strategically integrated into broader organizational practices (Zeshan et al., 2025). This perspective aligns with the emerging Industry 5.0 paradigm, which emphasizes integrating technological innovation with organizational, social, and sustainability-oriented considerations (Domenteanu et al., 2024). Industry 5.0 complements rather than replaces Industry 4.0; there is a real shift from purely technological efficiency toward a sustainable, human-centric model that puts workers' well-being at the core of their production processes (Breque et al., 2021). In this view, digital transformation is understood as a human-socio-technical process shaped by both internal organizational dynamics, such as changes in structures, processes, and skill requirements, and external pressures related to rapid technological advancements (Telukdarie et al., 2018).

Within this framework, the adoption of Industry 4.0 technologies can be interpreted as a necessary, but not sufficient, condition for the transition toward Industry 5.0, which places human resource management (HRM) at the center of organizational transformation processes (Fenwick et al., 2024). In this perspective, HRM is not only responsible for fostering openness toward technological innovation but also for ensuring that implementation processes remain human-centered (Wilkens et al., 2021). This includes creating conditions that support employee confidence in digital tools and encourage their meaningful use in daily activities. Promoting transparency and clear communication is essential in this regard. At the same time, the evolving digital scenario demands that employees acquire updated skills and knowledge. As a result, ongoing upskilling and reskilling become essential, generating value for both workers and the organization. The emerging roles associated with digital transformation call for continuous skill development to keep pace with the rapid technological advancement (Bresciani et al., 2021; Schwartz, 2024). In a context marked by swift technological and organizational shifts, organizations face growing pressures to anticipate future skill requirements (Whysall et al., 2019). Additional difficulties relate to attracting, developing, and retaining talent (Gallardo-Gallardo et al., 2020; Maley et al., 2024). These dynamics call for a re-evaluation of existing HR strategies, with greater emphasis on aligning workforce capabilities, organizational structures, and digital innovation processes in a sustainable manner.

Despite growing scholarly attention to digital transformation in organizational contexts (Gong & Ribiere, 2025; Hanelt et al., 2021; Omol, 2024), a significant research gap persists regarding the informing processes and their alignment with Industry 5.0 principles (Ghobakhloo et al., 2023, 2025; Pereira et al., 2025). Existing literature has predominantly focused on technological implementation as an output, neglecting the informing dynamics; that is, how knowledge, expectations, and digital practices are communicated, interpreted, and enacted across organizational layers. Little is known about how HR managers, positioned as key informers within organizational systems, perceive the effectiveness of current informing channels and what conditions enable or constrain meaningful, human-centered informing in contexts of rapid technological change.

To complement this conceptual framework and deepen our understanding of how digital transformation is experienced within organizational contexts, we conducted an exploratory qualitative study to capture perceptions, challenges, and expectations associated with emerging digital practices, offering insights into how employees interpret ongoing technological and organizational changes. Positioned at the intersection of innovation strategies and employee experiences, HR managers provide a

privileged vantage point on how Industry 4.0 technologies are implemented in practice and how these implementations may support or hinder the broader transition toward Industry 5.0. In particular, their perspective points out the ways in which digital tools intersect with workforce dynamics, employee engagement, and organizational culture.

MATERIALS AND METHODS

PARTICIPANTS AND PROCEDURES

Fourteen participants joined the study. They are employed in HR-related or managerial positions across Northern and Central Italy. Participants represented a range of organizational roles, including founders, general and innovation managers, consultants, and professionals responsible for people development, career management, recruitment, and training processes, ensuring strong alignment with the research objectives. Women represented 21.4% of the sample.

The interviewees worked in organizations of varying sizes, ranging from small enterprises with fewer than 50 employees to large companies with more than 500 employees. Participants also differed in terms of organizational tenure, with work experience in their current organization spanning from a few years to over twenty years, and represented diverse age groups, from under 40 to over 50 years. An overview of socio-demographic and professional characteristics is provided in Table 1.

Table 1. Sample socio-demographic and professional characteristics

ID	Gender	Professional role	Geographical area	Organizational size	Age	Tenure
P1	Male	Manager/CEO	Northern Italy	< 50 employees	> 50	> 5 years
P2	Male	General & Innovation Manager	Central Italy	< 50 employees	> 50	> 20 years
P3	Male	Manager/CEO	Central Italy	< 50 employees	< 40	10 years
P4	Male	HR Consultant	Northern Italy	< 50 employees	> 40	4 years
P5	Male	People & Career Development Manager	Central Italy	> 500 employees	40–45	> 10 years
P6	Male	HR Manager	Central Italy	~1,000 employees	> 45	> 10 years
P7	Male	Head of HR	Northern Italy	100–200 employees	40–50	5–10 years
P8	Female	VP Marketing & Sales with HR delegation	Northern Italy	50–100 employees	40–50	5–10 years
P9	Female	Head of HR	Northern Italy	50–100 employees	40–50	> 10 years
P10	Male	Corporate HR Officer	Northern Italy	> 2,000 employees	> 40	4 years
P11	Male	HR Manager	Northern Italy	> 100 employees	30-35	7 years
P12	Male	R&D and HR Professional	Central Italy	> 100 employees	> 50	2 years
P13	Female	HR Manager	Northern Italy	< 50 employees	< 40	4 years
P14	Male	HR Manager	Northern Italy	> 500 employees	< 40	3 years

METHODS

Data were collected through individual semi-structured interviews, primarily online; three were conducted in person. This mode of data collection allowed flexibility in scheduling and enabled participants to join from their preferred location, reducing geographical constraints while ensuring comparability of setting across almost all interviews. A shared semi-structured interview protocol, developed by the research team, was administered consistently across all participants to cover key thematic areas related to digital transformation in human resource management (e.g., adoption of digital tools, perceived changes in HR practices, challenges, and opportunities), while leaving room for probing

questions and in-depth exploration of participants' individual experiences. The interview lasted approximately 45 to 75 minutes. Before participation, all participants provided informed consent, and interviews were audio-recorded with permission.

All interviews were transcribed verbatim and analyzed using a thematic analysis approach informed by Corbin and Strauss (2008). The analysis was conducted through a two-level categorical coding process (macro categories and intermediate levels) applied to the transcripts of semi-structured interviews. Following iterative cycles of coding and interpretation, initial open coding was conducted to identify salient concepts and recurring issues within the data. Subsequently, axial coding was used to explore relationships between codes and to group them into broader conceptual categories. Throughout the analysis, constant comparison across interviews was employed to identify convergent and divergent patterns in digital transformation processes within HR practices. Thematic saturation was reached during the analytical process, as data analysis was conducted until no new themes emerged from the interviews. This process was carried out independently by two trained researchers, ensuring analytical rigor. Cohen's Kappa (0.85) was calculated, indicating strong agreement.

Analytical rigor was enhanced through repeated readings of the transcripts and systematic comparison between data segments and emerging categories. This qualitative approach does not aim for statistical generalization but rather to provide an in-depth, context-sensitive understanding of how digital transformation is experienced and interpreted by HR professionals and managers.

RESULTS

The integrated categorical three allowed for the identification of 8 thematic macro-categories, organized into 35 sub-themes, for a total of 102 coding units (textual citations). Table 2 presents the frequency distribution per macro-category.

Table 2. Distribution of citations by macro-category (N=102)

Macro-category	N citations	% of total (N=102)
Change management	29	28.4%
Skills and resources of the 4.0 leader	14	13.7%
Disadvantages and risks of Industry 4.0	14	13.7%
4.0 Worker skills and training	13	12.7%
Definition of Industry 4.0	13	12.7%
Advantages of Industry 4.0	8	7.8%
4.0 Technologies	6	5.9%
Worker resources	5	4.9%
Total	**102**	**100%**

As highlighted in Table 2, the most salient theme across the entire corpus is Change Management, accounting for 28.4% of all coding units (n=29). This frequency reflects the centrality of the organizational and procedural dimensions of Industry 4.0 implementation in participants' discourse rather than purely technological aspects. Following this, the equivalent frequencies (n=14, 13.7% each) are the macro-categories of skills and resources of the 4.0 leader and the disadvantages and risks of Industry 4.0, indicating that reflection on leadership profiles and risk awareness occupy equal discursive space among participants. The macro-categories 4.0 workers' skills and training and definition of Industry 4.0 show similar frequencies (n=13, 12.7% each): the conceptualization of the phenomenon and its impact on skills carry comparable weight in the corpus. The themes related to Advantages (n=8, 7.8%), 4.0 Technologies (n=6, 5.9%), and worker resources (n=5, 4.9%) appear less extensive

in terms of citations yet remain coherent with the main interpretative frameworks. The Appendix reports the frequency distribution of the intermediate level (sub-theme) within each macro-category.

To bridge the gap between the raw qualitative findings and a functional Human Resource framework, the eight initial categories were synthesized into three strategic pillars: recruitment and selection, talent management, and training and education. This reclassification aligns the empirical data with the employee lifecycle, effectively linking the challenges of digital transformation to the practical need of talent acquisition and continuous professional development.

Following this logic, Table 3 provides a detailed mapping of the qualitative findings onto the three strategic pillars, to underline how specific interview insights translate into concrete HR priorities. This framework serves as a roadmap for understanding the organizational impact of Industry 4.0 through the lens of human capital management.

Table 3. Mapping of qualitative findings onto three strategic pillars

Strategic pillar	Relevant themes and sub-themes (from Table 2)	Total frequency (n)	% of total citations
Recruitment & Selection	*Definition of Industry 4.0:* Revolution, human-machine collaboration. *Disadvantages & Risks:* Assessing management complexity and lack of true application.	27	26.4%
Talent Management	*Change Management:* Team building, willingness to change, strategy. *Worker Resources:* People management and managing unforeseen events. *Advantages:* Innovation and economic benefits.	42	41.2%
Training & Education	*4.0 Technologies:* Training on implemented and upcoming systems. *Change Management (Sub-Theme):* Formal training programs. *Disadvantages & Risks:* Technical understanding and sense-making.	33	32.4%

RECRUITMENT AND SELECTION

Interviews show that digital transformation is profoundly reshaping how organizations identify, assess, and select candidates. Participants conceptualize Industry 4.0 primarily as a revolution – a structural discontinuity from previous production models – and as a necessary process of human-machine collaboration, in which the human factor retains a decisive role despite technological integration. This shared understanding shapes how HR managers approach talent acquisition: rather than focusing exclusively on technical skills, organizations are shifting toward a broader evolution that prioritizes adaptability, digital mindset, and learning agility. As one HR manager noted: "Until three years ago, we selected candidates based solely on their technical skills. Now, however, we focus primarily on soft skills." (P.2). Another practitioner emphasizes the growing importance of digital readiness: "We need to transform workers and make them 4.0, otherwise we won't get anywhere." (P.5). This evolution affects not only the skills sought but also the assessment methods. In addition to traditional interviews, organizations increasingly integrate gamified assessments, challenge-based tasks, and digital platforms to simulate real work conditions and observe candidates' reactions to uncertainty – tools

that help identify individuals able to adapt to dynamic environments, collaborate effectively, and demonstrate openness to innovation. As one interviewee put it: "An individualistic person struggles a lot in today's workplace … Industry 4.0 challenges cannot be tackled alone." (P.11).

At the same time, the selection process must account for the risks and obstacles that characterize digital transformation. Participants identify management complexity and the need for meaningful understanding as the two dominant challenges (n=5 each; 35.7%): technologies must be internalized before they can be effectively adopted, and resistance to change – especially among more senior workers – represents a significant obstacle. This implies that recruitment must increasingly assess not only technical readiness but also candidates' capacity to navigate ambiguity, make sense of change, and bridge the gap between the formal introduction of tools and their actual use – a risk explicitly flagged as a lack of genuine application (n=2, 14.3%).

Several practitioners also highlight the need to align employer branding with the selection process. Companies that present themselves as innovative or digital-first must adopt coherent practices; otherwise, the candidate's experience risks appearing inconsistent or outdated. In sum, according to participants, recruitment and selection are shifting toward a holistic model in which behavioral adaptability, collaboration, and a digital mindset are as important as technical competence in identifying individuals who can grow, adapt, and contribute meaningfully to technologically advanced contexts.

Talent Management

Once hired, managing and retaining talent has become a strategic priority for organizations navigating digital transformation. HR managers emphasize that talent management today extends beyond onboarding, requiring the creation of conditions that support continuous learning, foster innovation, and allow employees to evolve alongside technological and organizational change. The qualitative data reveal that change management is the most extensively discussed theme in this domain (n=29; 28.4%), with implementation processes articulated across seven distinct sub-themes. At its core lies team building (n=8; 27.6%), which involves engaging personnel from the earliest project phases, identifying flexible individuals open to change, clearly assigning responsibilities, and involving trade union representatives who, once engaged, become potential sponsors of the process. Equally central is the willingness to change (n=5; 17.2%), understood as a subjective precondition of transformation: here, participants emphasize the importance of personal conviction among change promoters and the ability to build a shared vision.

A key challenge involves developing the competencies needed in a digitalized environment. Updating technical skills is essential, but soft skills such as communication, teamwork, adaptability, and critical thinking are equally important. As one respondent explained: "It is essential to train workers in managerial aspects, focusing on how to carry out projects, take action, be more effective, and work better together." (P.5). This reflects the growing need to cultivate a digital mindset, not just technical proficiency – a need further supported by the workers' resources identified in the data: people management skills and the capacity to manage change contingencies (n=2 each; 40%), alongside stress management (n=1; 20%), are flagged as essential individual resources in Industry 4.0 contexts.

Talent management also includes identifying and developing future leaders who can guide teams through digital transitions. The data sketch a distinctive leadership profile: leadership recognized by others emerges as the dominant sub-theme (n=7; 50%), describing an authority that is not formally assigned but collectively acknowledged – the leader as a coach who brings experience at the service of the team and enables each person to play to their strengths. Mentoring skills (n=3; 21.4%) and communication, motivation, and listening competencies complete this profile, alongside project management – identified as emerging but still underdeveloped: "without a director, projects struggle to reach completion". Cross-functional collaboration emerges as particularly important: "One of the key innovations brought by Industry 4.0 is teamwork" (P.2). The theme of intergenerational conflict – evoked through the metaphor of "two generations glaring at each other" – runs transversally through this domain, linking the leader figure to the need to mediate between different work cultures.

Retention strategies require a proactive approach to talent pipelines, succession planning, and career development. "It is necessary to absorb and filter an incredible amount of information and be prepared to significantly change roles, possibly within just a few years." (P.4). Employees expect growth opportunities, reskilling, and internal mobility; organizations that fail to provide these chances risk losing high-potential talent. The advantages of digital transformation, while present in the data, are comparatively understated (n=8; 7.8%). Participants identify innovation n=5; 62.5%) (understood as a qualitative transformation of work practices, greater goal-orientation, and the enablement of new processes) and economic benefit (n=3; 37.5%) through operational efficiency gains. The limited weight of this theme suggests that participants tend to place greater emphasis on the challenges and human processes of change than on their expected returns.

Ultimately, effective talent management requires balancing technological innovation with a human-centered approach. Despite digital tools supporting decision-making, the human factor remains central: "Despite the contribution of machines, the human factor remains a decisive element in innovation processes and in driving the company forward" (P.12). Developing adaptable, engaged, and continuous learning employees is essential for retention and for sustaining organizational resilience in the digital age.

A balance between technological innovation and a human-centered approach, the effort for continuous learning, and providing employees with growth opportunities to nurture their potential seem to be key aspects for effective talent management.

Training and Education

Innovation-driven or digitalization processes require concrete attention to training. This represents not only a lever for change but also a contribution to employee well-being (Haepp, 2022). Qualitative data situates this commitment within a clear technological landscape: among the Industry 4.0 tools already in use, participants mention MES (Manufacturing Execution System), electronic screwdrivers with data analysis capabilities, and 3D printing, while automation of incoming goods controls is being implemented and supply chain digitalization remains on the horizon. Notably, this technological theme is among the least discussed in the corpus (n=6, 5.9%), a finding consistent with the broader interpretive picture: participants' reflection tends to shift from tools to the human processes that condition their adoption. The increasing complexity of roles is reflected in the evolution of traditional tasks. As one HR manager noted: "the machinists must now also analyze work data, whereas before they only made the piece. The work shifts from being often purely manual and mechanical to a more conceptual type of work" (p.2). This transition is confirmed by the competency data: technical training dominates workers' competency profile (n=4; 30.8%), functioning as an enabling condition for the effective use of digital systems – workers must know how to analyze data, not merely produce output. Yet technical proficiency alone is insufficient. Teamwork skills (n=3; 23.1%) and critical thinking (n=2; 15.4%) emerge as significant cross-cutting competences, with participants explicitly valuing diverse collaboration and the capacity to question ongoing processes critically.

Openness to change, communication and listening skills, management training, and flexibility and adaptability each appear with equal frequency (7.7%), together sketching the profile of a hybrid worker capable of integrating specific technical competencies with relational and adaptive resources. The discussion is no longer about replacing humans with machines, but about complementarity and continuous interaction between humans and technology. This requires developing multidimensional competencies that combine soft and hard skills. Managers organize diverse learning environments in response: as HR managers reported, "Workers need to be trained on managerial aspects, on how to carry out projects, how to take action, how to be more effective, and how to work better together… problem solving, communication, working together are essential" (P.9). A human-centered approach is reflected in practices. The increasing complexity of roles is reflected in the evolution of traditional tasks. A human-centered approach is reflected in practices such as reverse mentoring, that is the

practice in which a junior employee teaches digital skills and shares new trends with senior colleagues, fostering generational interchange (Gadomska-Lila, 2020; Li et al., 2024; Pandey & Singh, 2026): "what is called reverse mentoring has been useful for us" (P.5). Cross-functional and horizontal training is also emphasized: "One of our goals, however, is not just to create a group of workers who know how to manage the warehouse, but rather, to make the training transversal across all the staff members present" (P.7). This promotes cohesion, collaboration, and knowledge sharing among teams. Practical learning is another key aspect: "A lot of attention should be given to practical experimentation, so that people can try things out, raise doubts, and have their own learning pace in a concrete way" (P.7). Personalizing training activities ensures genuine engagement and maximizes learning outcomes. This evidence from participants highlights the growing importance of multidimensional approaches to training practices and the combination of technical and soft skills, with a central role for human-technology complementarity.

DISCUSSION

This study examined how HR managers interpret and manage digital transformation in strategic practices such as recruitment, talent management, and training. Findings reveal that digital transformation, often conceptualized primarily as a technological evolution, is experienced by practitioners as an organizational and cultural shift that redefines expectations for skills, roles, and learning processes. Across domains, the results highlight strong convergence between managerial discourse and emerging theoretical perspectives in the Industry 5.0 landscape. HR managers emphasize the importance of aligning digital technologies with organizational structures, workforce capabilities, and learning practices, reflecting an understanding of digital transformation as a socio-technical process grounded in human-technology complementarity rather than solely in technology-driven change. Despite growing attention and research on digital transformation and HRM, significant gaps remain in the literature. Existing research has extensively examined the technical skill requirements associated with Industry 4.0 (Bag et al., 2021; Jerman et al., 2020), while the organizational and cultural implications for HR practices remain underexplored, with specific regard to the emerging Industry 5.0 (Fenwick et al., 2024; Wilkens et al., 2021). Furthermore, past research has identified a growing gap between the competencies currently available and those required by future digital environments (Whysall et al., 2019), yet little is known about how HR managers can practically address this challenge. Most studies adopted quantitative approaches; literature remains scarce on qualitative, experience-based managerial perspectives. This study addresses these gaps by offering an in-depth exploration of how HR managers in Italian companies interpret and enact digital transformation, contributing to a more grounded understanding of human-centric digitalization in practice.

REFRAMING SKILLS AND COMPETENCIES IN INDUSTRY 5.0

One of the central findings concerns the redefinition of skills required in digitalized workplaces. HR managers increasingly prioritize adaptability, collaboration, and learning agility over purely technical competencies. However, they consistently described tensions between the affordances of Industry 4.0 tools and employees' actual capabilities, expectations, and well-being. This shift aligns with research showing that Industry 5.0 demands hybrid profiles able to combine digital literacy with transversal skills such as problem-solving, teamwork, and critical thinking (Ghassoul & Messaadia, 2023; Modgil et al., 2025). However, the results suggest that this transition is not merely a shift in skill requirements but a deeper cultural re-orientation toward continuous learning and flexibility. Managers perceive these competencies as essential not only for job performance but for adapting to constant technological change. Literature supports these trends. Industry 5.0 requires not only technical skills but also collaboration and problem-solving abilities (Bag et al., 2021; Jerman et al., 2020). A human-centered approach is critical to AI-driven digital transformations, emphasizing adaptability and soft skills alongside technical competence (Poláková et al., 2023; Tóth et al., 2023). These reframing echoes human-centric approaches to AI and digitalization, which emphasize the centrality of employee adaptability and agency in technology adoption (Fenwick et al., 2024; Wilkens et al., 2021). However,

the reflections of these HR managers need to be situated within a broader context in which workplace digitalization is often portrayed in predominantly optimistic terms.

Much of the public and managerial discourse emphasizes gains in efficiency and innovation, while offering less space to consider the unintended consequences that technological change may introduce for employees and organizations. The adoption of digital tools stretches across sectors and organizational forms, reshaping tasks, work relationships, and expectations in uneven ways. As such, the same technologies that open new possibilities for autonomy, collaboration, or flexibility can also create new pressures. These can include technostress, defined as the difficulty to face and implement new digital technologies healthily (Molino et al., 2020; Sulla et al., 2024), and perceived surveillance, meant as Foucault's panopticon metaphor, so that individuals regulate their behavior accordingly to the perceived control (Foucault, 2020), as well as concerns about job stability or the erosion of role boundaries (Morandini et al., 2023). A more critical and balanced view is therefore needed to understand how digital transformation is experienced, and to avoid treating it as an inherently neutral or universally beneficial process (Tommasi et al., 2025).

Rethinking Talent Management in Digital Transformation

Talent management emerges as a domain in which digital transformation introduces both opportunities and tensions. Organizations adopt broader, more dynamic approaches to developing and retaining talent, integrating continuous learning, cross-functional collaboration, and leadership development. This reinforces recent scholarship highlighting how Industry 4.0 disrupts traditional career models and requires more fluid talent pipelines (Galanti & Fantinelli, 2025; Whysall et al., 2019). Job crafting and job resources are also critical to maintaining engagement in digital work environments (Zeshan et al., 2025). Furthermore, reverse mentoring has been shown to enhance engagement, inclusion, and knowledge sharing, supporting talent development (Chaudhuri et al., 2022).

At the same time, the results reveal a strong emphasis on relational and cultural dimensions of talent development. Managers highlight the importance of practices that enhance inclusion, knowledge sharing, and collective identity, such as cross-functional initiatives and reverse mentoring. These findings suggest that the social architecture of digital transformation is at least as important as its technological dimension. In this sense, talent management becomes a mechanism for reinforcing organizational cohesion and contrasting the fragmentation associated with new forms of digital work.

Furthermore, in line with the vision articulated in the European Commission's Industry 5.0 agenda (Breque et al., 2021), a human-centric approach invites organizations to view technological innovation not only through the lens of productivity or efficiency, but also as a process that should safeguard well-being and meaningful work. HR management is uniquely positioned to support this shift. Acting at the intersection of strategic decisions around digital investment and the everyday realities of employees, HR professionals can influence how changes are communicated, how learning pathways are designed, how leadership adapts, and how organizational cultures evolve during technological transitions (Fregnan et al., 2020; Guzmán et al., 2020). By examining how HR managers in Italian companies interpret and navigate digital transformation, this paper contributes to a more grounded understanding of what human-centric digitalization entails in practice, and of the concrete levers HR can mobilize to ensure that technological progress strengthens, rather than undermines, the human experience of work. Our findings highlight the key role of HR managers as mediators between technological systems and human actors within an organization. This is consistent with the conceptualization of mediation as the process through which informers translate, filter, and contextualize information to make it actionable for informers (Cohen, 1999). The data reveal that when mediation processes are weak or absent, digital tools fail to generate meaningful organizational change.

Recognizing Training as a Lever for Human-Technology Complementarity

Training is perceived as the key strategic resource enabling organizations to integrate new technologies while sustaining employee well-being and performance. The emphasis on multidimensional, experiential, and personalized learning reflects a broader perspective in which employees are not passive to technological change but active co-constructors of new work practices (Haepp, 2022; Ismail et al., 2017). Furthermore, the literature suggests that well-designed training programs can promote critical thinking, engagement, cohesion, and identification with the organization, representing a strategic factor in the successful implementation of digital transformation (Chaudhuri et al., 2022; Ismail et al., 2017; Johnston, 2021).

The findings also suggest that training serves two complementary functions. First, it develops the technical and transversal skills needed to interact effectively with smart systems and data-driven infrastructures. Second, it supports the emotional and cognitive adaptation required to operate in environments characterized by uncertainty, accelerated change, and evolving role expectations. This dual role reinforces the argument that training is central to fostering human technology complementarity rather than substitution.

The current study is not without its limitations. The study is qualitative and based solely on managers' perceptions, which may not fully reflect employees' experiences or organizational outcomes. Future research could triangulate managerial perspectives with employee-level data, longitudinal analyses of skill development, or comparative studies across sectors. Additionally, examining the impact of specific technologies, such as AI-enabled tools, collaborative robots, or predictive analytics, on HR practices could refine the understanding of the dynamics identified here.

However, the findings point to strategic implications for organizations seeking to navigate digital transformation effectively and human-centrally. First, recruitment and selection practices require a fundamental shift toward identifying candidates who demonstrate adaptability, learning orientation, and digital openness. Rather than focusing primarily on static technical qualifications, HR professionals should incorporate assessment methods that capture candidates' potential to learn, collaborate, and respond constructively to technological change. This approach enables organizations to build a workforce capable of evolving with shifting technological demands rather than constantly reacting through urgent skill-acquisition cycles.

In parallel, talent management should move toward developmental architectures that facilitate cross-functional mobility, knowledge sharing, and a strong collective identity during periods of technological transition. The results underscore that digital transformation risks increasing fragmentation, especially in hybrid and distributed work environments. HR leaders and consultants can address this by creating structured opportunities for interdepartmental collaboration, such as rotational assignments, cross-functional project teams, and mentoring. Continuous learning also becomes a central strategic lever. Training should be reconceptualized not only as a vehicle for technical upskilling but as an integrative process that simultaneously develops cognitive, emotional, and social competencies. Experiential learning formats, personalized learning pathways, adaptive digital training platforms, and coaching interventions can address heterogeneous needs and reduce uncertainty tied to evolving roles. Importantly, training should also support employees' emotional adjustment by fostering resilience, enhancing sense-making of technological change, and enabling individuals to articulate their concerns and expectations.

Leadership emerges as a decisive condition for successful digital transformation. Managers need to cultivate psychological safety, openly acknowledge the uncertainties and tensions introduced by new technologies, and model a constructive attitude toward experimentation. Leaders who frame digital innovations as opportunities for learning foster climates in which employees feel empowered to try new tools, question existing processes, and share emerging insights. Such environments enable high-

quality, adaptive learning cycles and reduce the risk that digital transformation triggers resistance or disengagement.

At a broader level, the findings point to several implications for policymakers. Public institutions can play a pivotal role in enabling equitable and sustainable digital transformation by expanding access to lifelong learning opportunities and supporting organizations' reskilling efforts. Financial incentives for continuous training, national frameworks for certifying digital skills, and partnerships between educational institutions and industry can help ensure that the labor force develops the hybrid competencies required in Industry 5.0.

CONCLUSION

This study indicates that successful digital transformation depends on aligning technological innovation with human-centered HR strategies. Recruitment practices increasingly focus on candidates' adaptive capacities; talent management prioritizes learning collaborations and identity-building; and training programs emphasize experiential, inclusive approaches that support continuous development. Together, these elements point to a holistic model in which human capabilities and organizational culture are core drivers rather than secondary consequences of digital transformation.

Moreover, this transition represents a fundamental challenge. The findings reveal that effectiveness depends on the quality of the sense-making processes enabled by digital tools, the strength of the mediation structures through which HR managers connect technological innovation to human actors, and the extent to which human-technology interaction remains genuinely human-centered. In this sense, the authors intended to adopt a transdisciplinary lens for analyzing digital transformation beyond technological adoption, repositioning the organizational and human dimensions as constitutive of, rather than contingent upon, effective informing systems.

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APPENDIX: FREQUENCIES BY MACRO-CATEGORY AND SUB-THEME

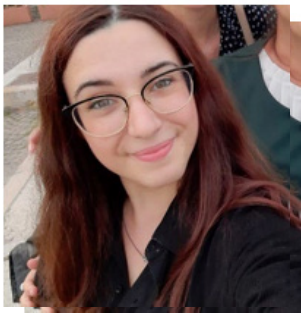
Macro-category	Sub-theme (intermediate level)	N	%
Definition of Industry 4.0 (N=13)	Revolution	5	38.5%
	Human-machine collaboration	4	30.8%
	Necessity	2	15.4%
	The trend of innovation	1	7.7%
	Data management	1	7.7%
Advantages of Industry 4.0 (N=8)	Innovation	5	62.5%
	Economic benefit	3	37.5%
Disadvantages and risks of Industry 4.0 (N=14)	Management complexity	5	35.7%
	Need for meaningful understanding	5	35.7%
	Lack of genuine application	2	14.3%
	Economic investment	1	7.1%
	Need for technical understanding	1	7.1%
Industry 4.0 technologies (N=6)	Implemented	4	66.7%
	Being implemented	1	16.7%
	To be implemented	1	16.7%
Change management (N=29)	Team building	8	27.6%
	Willingness to change	5	17.2%
	Situation analysis	4	13.8%
	Contingency management	4	13.8%
	Training	4	13.8%
	Communication and interface	2	6.9%
	Strategy	2	6.9%
Workers' resources (N=5)	People management skills	2	40.0%
	Managing change contingencies	2	40.0%
	Ability to manage change consequences	1	20.0%

Macro-category	Sub-theme (intermediate level)	N	%
Industry 4.0 workers' competencies and training (N=13)	Technical training	4	30.8%
	Teamwork skills	3	23.1%
	Critical thinking	2	15.4%
	Openness to change	1	7.7%
	Communication and listening skills	1	7.7%
	Management training	1	7.7%
	Flexibility and adaptability	1	7.7%
Leader 4.0 competencies and resources (N=14)	Leadership recognized by others	7	50.0%
	Mentoring skills	3	21.4%
	Communication/motivation/listening skills	3	21.4%
	Project management	1	7.1%

AUTHORS

Teresa Galanti is an Assistant Professor in Work and Organizational Psychology at the University of Chieti-Pescara. Her main research interests are related to safety management, talent development, and digital transition at work. She has been involved in national and European-funded research projects on talent management and development.

Stefania Fantinelli is an Associate Professor in Work and Organizational Psychology at the E-Campus University (Rome, Italy). Her main research interests are related to organizational behavior and the impact of technology on working life, both at the individual and collective dimensions.



Giulia Paganin (PhD) is an Assistant Professor in Work, Organizational, and Personnel Psychology at the University of Bologna (Italy). Her main research interests include work-related stress and psychosocial risks, employee well-being, acceptance of technology and artificial intelligence, sustainable employability, and emerging work-related behaviors such as quiet quitting. She has been involved in national and European research projects focusing on mental health promotion and well-being at work.

Dr. Federico Fraboni is a researcher with a background in Work, Organizational, and Personnel Psychology. He holds a PhD in Psychology from the University of Bologna. He has expertise in human-technology interaction, human-robot collaboration, and safety in high-risk organizations. His current research focuses on cognitive workload, technology acceptance, human-machine interfaces, and risky behaviours in the workplace. He has participated in various European-funded research projects and has collaborated with private companies on internally funded projects. He is currently a researcher in the Human Factors Risk and Safety research unit of the University of Bologna.

Francesco Tommasi is Assistant Professor in Work and Organizational Psychology (Università degli Studi di Milano, Italy). His research interests cover the lived experience of subjects at work and new forms of organizing work. In his research, he is particularly interested in contributing to the development of critical perspectives in social and organizational psychology.

Gabriele Puzzo, PhD, HR Business Partner, is a human resources professional with seven years of experience in corporate consulting. During his industrial PhD, he worked with organisations such as Hera S.p.A., contributing to strategic HR projects aimed at optimising organisational processes. He has also collaborated on the drafting and management of H2020 and LIFE projects, combining project management skills with multi-level analysis.

Monica Molino (PhD) is an Associate Professor of Work and Organizational Psychology at the Department of Psychology, University of Turin (Italy). She also serves as General Secretary of the European Association of Work and Organizational Psychology (EAWOP). Her main research interests include: (a) employee well-being, with a particular focus on the work-nonwork interface and its potential outcomes, such as burnout, work-family conflict, and work addiction; (b) Industry 5.0 and the use of technologies for work-related purposes; (c) meaning of work and work-related values; and (d) entrepreneurship and innovation.