

Tatjana Jovanović¹, Polona Šprajc², Olja Arsenijević³

Employees' Digital Competences and Holistic HRM 4.0: Learning Challenges in Organisations in Serbia

Abstract: Digital transformation is reshaping how work and learning take place within organisations, making the development of employees' digital competences a central challenge for contemporary HRM. This study examines the prevalence of holistic HRM elements in Serbian organisations from the perspective of HR professionals. Using the author-developed HHRM 4.0 instrument and a sample of 104 respondents, the analysis shows that the overall prevalence index is 55%, indicating only partial implementation. The highest scores were documented in the fields of work flexibility and interdepartmental collaboration and the lowest with respect to employee engagement technologies, digital analytics and KPIs and the strategic development of digital skills. The findings highlight the need for integrated andragogically grounded approaches to workplace learning.

Keywords: digital competences, holistic HRM, adult learning, digital transformation, learning in organisations

Digitalne kompetencije zaposlenih i holistički HRM: izazovi učenja u organizaciji u Srbiji

Apstrakt: Digitalna transformacija menja načine na koje se rad i učenje odvijaju u organizacijama, čineći razvoj digitalnih kompetencija zaposlenih centralnim izazovom savremenog upravljanja ljudskim resursima. U ovom istraživanju se ispituje rasprostranjenost elemenata holističkog HRM-a u organizacijama u Srbiji iz perspektive HR profesionalaca. Rezultati primene instrumenta HHRM 4.0 koji je razvila autorka na uzorku od 104

¹ Faculty for Engineering Management, Serbia, <https://orcid.org/0000-0002-3400-3467> (tatjana.jovanovic1@yahoo.com)

² University of Maribor, Slovenia, <https://orcid.org/0000-0003-1356-3438> (polona.sprajc@um.si)

³ Institut of Serbian Culture, Serbia, <https://orcid.org/0000-0002-0465-0508> (arsenijevicolja@gmail.com)

ispitanika pokazuju da je ukupni indeks rasprostranjenosti 55%, što ukazuje na samo delimičnu implementaciju. Najviše vrednosti zabeležene su u oblastima fleksibilnosti rada i međufunkcionalne saradnje, dok se najniže ocene odnose na primenu tehnologija za angažovanje zaposlenih, digitalnu analitiku i ključne pokazatelje uspešnosti (KPI), kao i na strateški razvoj digitalnih veština. Nalazi ukazuju na potrebu za integrisanim andragoški utemeljenim pristupima učenju na radnom mestu.

Ključne reči: digitalne kompetencije, holistički HRM, učenje odraslih, digitalna transformacija, učenje u organizaciji

Introduction

The Fourth Industrial Revolution has brought accelerated digitalisation of organisational processes, business models and work environments. Technologies such as artificial intelligence, advanced analytics, automation and digital platforms are reshaping competence requirements and redefining the role of the human resource (HR) function (Schwab, 2017). In this context, traditional oriented HR models are no longer sufficient to support learning in organisational contexts, flexibility and the adaptability of adults in the workplace (Kalvakolanu & Prasad, 2023; Strohmeier, 2020).

HR management 4.0 (HRM) concepts therefore emphasise the need for the HR function to operate in a strategic, integrated and proactive way, using digital tools for decision-making, competence development and support to business transformation (Meijerink et al., 2021; Strohmeier, 2020). A holistic approach to human resource management entails viewing HR practices as a system that integrates digital technologies, competence development, a culture of innovation, sustainable business and high-quality communication between management and employees (Meijerink et al., 2021).

In the field of adult education and andragogy, these processes are of direct relevance. The workplace represents the key context for adult learning, while the way in which an organisation designs its HR policies directly affects access to training, the development of digital skills, motivation to learn and the engagement of employees in innovation processes (Poór et al., 2020; Ravichandran, 2018; Vuorikari et al., 2022). Participation in continuous learning is strongly influenced by both individual factors and organisational support mechanisms, which shape employees' motivation, learning behaviour and the transfer of new skills into work practice (Feldman & Ng, 2021). Without adequate support for learning, digital transformation may deepen the gap between required and existing competences, whereas a holistic HRM (HHRM) approach has the potential

to reduce this gap through coordinated processes of competence development, innovation and workplace learning. Recent studies also show that upskilling and reskilling initiatives play a central role in building a learning-oriented organisational climate and enabling employees to adapt to rapid technological change (Hasan et al., 2024).

Although digital transformation has been widely discussed in recent years, empirical studies that examine multiple HRM domains in an integrated way remain limited, especially in developing countries and post-socialist economies (Poór et al., 2020). Scholars tend to analyse isolated aspects such as digital skills, organisational culture or flexible work arrangements, while research that connects these elements into a comprehensive or holistic HRM framework is considerably less common (Meijerink et al., 2021; Strohmeier, 2020). There are even fewer studies that approach this question from the perspective of HR professionals – the actors who are crucial for designing training programmes, developing competences and implementing digital initiatives.

Hence the clear need for empirical studies that analyse HR professionals' perceptions of the extent to which holistic HRM practices are implemented in various organisational contexts (public, private, domestic and foreign organisations). This paper seeks to address this gap. The study examines the degree of prevalence of holistic human resource management elements under Industry 4.0 conditions in organisations in the Republic of Serbia, observed from the perspective of HR professionals. Particular attention is paid to dimensions that are directly linked to adult learning and the development of digital competences – training provision, support for skills development, a culture of innovation, work flexibility and organisational communication about digital transformation.

The empirical basis of this study relies on the application of the Holistic HRM in Industry 4.0 instrument (HHRM 4.0), developed by the authors on the basis of an eclectic, interdisciplinary theoretical framework that integrates key concepts relevant to holistic HRM, including digital transformation (Westerman et al., 2011) and the diffusion of the innovations theory (Rogers, 2003). Data were collected from 104 HR professionals employed in organisations varying in ownership structure, sector and size. In addition to assessing the overall prevalence of HHRM practices, the study examines differences across gender, position, ownership structure, sector and age, using appropriate non-parametric statistical techniques.

The central research question is:

Is holistic HRM in organisations in Serbia sufficiently widespread to support adult learning and the development of employees' digital competences under Industry 4.0 conditions?

The paper further addresses the following sub-questions:

1. Which elements of holistic HRM are most prevalent and which are the least developed?
2. Are there differences in the perceived implementation of holistic HRM depending on the respondents' gender, professional role and organisational characteristics?
3. What implications do the findings have for competence development and employee learning programmes?

Theoretical Background

Digital transformation, as a key feature of the Fourth Industrial Revolution, strongly influences how organisations function, how work is carried out and how employees learn, acquire competences and adapt to change. The introduction of technologies, such as artificial intelligence, advanced analytics, the Internet of Things, automation and digital platforms, leads to deep changes in organisational dynamics and requires a redefinition of the role of the HR function (Schwab, 2017). In such a context, traditional, administratively-oriented HR models become insufficient and literature increasingly emphasises the need for a strategic, integrated and transformative approach to HRM (Hinings et al., 2018; Kane et al., 2015; Strohmeier, 2020).

A holistic approach to HRM represents precisely such a paradigm. It entails viewing HR practices as a mutually connected system that encompasses core HR processes, including competence development, as well as organisational culture, digital infrastructure, innovativeness, sustainability and the quality of communication. The essence of holistic HRM lies in positioning HR as an actor that connects business strategy, workplace learning and employees' professional development, thereby creating conditions for successful functioning in a digitally transformed work environment (Meijerink et al., 2021). Contemporary studies confirm that organisations opting for integrated HR approaches adapt faster to technological change and more successfully develop a competent, flexible and innovative workforce (Poór et al., 2020).

Industry 4.0 acts as a powerful catalyst of these changes. Digital technologies affect not only work processes, but also the competences of employees, modes of learning and the shaping of professional identities. Literature stresses that digital transformation cannot be reduced to a technological issue; it is primarily an organisational and cultural change that requires continuous learning,

the development of new skills and shifts in mindsets (Hinings et al., 2018; Kane et al., 2015). Within this context, the HRM 4.0 concept emerges, integrating digital tools and analytics into HR practices, enabling personalised training and data-driven decision-making. Recent literature also shows that AI-enabled HR solutions can significantly enhance the efficiency and accuracy of HR processes, while simultaneously introducing new capability requirements, infrastructure demands and cultural expectations for HR professionals and employees (Agustono et al., 2023).

Digital HR analytics or people analytics is a particularly important component of HRM 4.0; it enables more precise training planning, the identification of competence gaps and the optimisation of selection and development processes. Technological progress also significantly shapes the nature of learning in organisations. According to contemporary andragogical theories, the workplace has become a key context of adult learning, in which informal and non-formal learning, experimentation and collaboration dominate. Digital transformation reinforces these processes, offering employees more opportunities to develop digital skills through everyday work, while the HR function is tasked with creating an environment that supports such forms of continuous learning. In addition, organisations play a central role in enabling the employees' participation in continuous learning and in supporting the transfer of newly acquired knowledge into work behaviour, which directly influences skill development and performance (Feldman & Ng, 2021).

Organisational culture plays a critical role in the adoption of digital innovations. Research shows that employees' readiness to adopt new technologies depends on clear management communication, perceived usefulness, opportunities for experimentation and visibility of results – dimensions derived from Rogers' diffusion of innovations theory (Rogers, 2003). Contemporary studies confirm the applicability of this framework to the digital transformation of HR functions: employees more easily adopt technologies when they perceive their relative advantage, view them as compatible with their work and have the opportunity to try them out in a safe environment (Kane et al., 2015; Ravichandran, 2018).

Digital transformation also introduces new requirements in terms of work flexibility, remote work and access to learning. These changes have led to growing emphasis on the need to design adaptive, personalised and technology-supported development programmes for employees (Allen et al., 2015; Vuorikari et al., 2022). At the same time, research shows that different age groups of employees display distinct learning preferences and approaches to acquiring new skills, making generational differences an important factor in planning HR and educational interventions (At Thaariq, 2023).

Taken together, these aspects demonstrate that holistic HRM under Industry 4.0 conditions is crucial for building learning organisations. The integration of digital tools, training support, an innovation-oriented culture, sustainable business and high-quality communication creates conditions for rapid adaptation, competence development and employee engagement (Meijerink et al., 2021; Poór et al., 2020). Empirical examination of the prevalence of such practices – particularly from the perspective of HR professionals – is therefore important both for HRM theory and for andragogical practice and the development of employees' competences in the digital era.

From an andragogical perspective, it is important to distinguish between the concepts of organisational learning and learning in organisations. In literature, organisational learning is commonly understood as a collective and systemic process through which organisations develop shared knowledge, routines and practices embedded in organisational structures (Elkjær, 2004). In contrast, andragogical perspectives emphasise learning in organisations, which refers to individual and group learning processes that take place within organisational contexts and are shaped by work-related conditions and HR practices (Illeris, 2018). This study adopts the latter perspective, as its analytical focus is on how HR practices shape opportunities for adult learning, skill development and competence acquisition among employees. While elements of organisational learning may emerge as outcomes of these processes, they are not examined as an autonomous theoretical construct. This clarification is essential in order to avoid conceptual ambiguity and to ensure alignment with andragogical theory. Accordingly, this study is conceptually grounded in the perspective of learning in organisations, rather than organisational learning as a collective-level construct.

Methodology

This study employed a quantitative research design and a structured questionnaire to examine the extent to which elements of holistic human resource management under Industry 4.0 conditions are implemented in organisations in Serbia. Data collection was conducted in February and March 2025 among HR professionals working in organisations varying in ownership structure, size and sector.

Of the 315 HR professionals invited to participate, 119 completed the questionnaire. After excluding invalid responses through an attention-check item, the final sample consisted of 104 respondents. A convenience sampling strategy was used, which is common in HRM research due to the sensitivity of HR data and limited access to organisational populations. The sample included

organisations of various sizes, sectors and ownership structures, providing a reasonable level of external validity.

The HHRM 4.0 instrument, developed specifically for this research, is based on contemporary HRM theory and an interdisciplinary framework drawing on digital transformation, innovation studies, learning in organisational contexts, diffusion of innovations theory and adult education. The instrument was intentionally designed to capture a broad range of interrelated HR practices relevant to HRM 4.0, including the use of digital technologies in HR processes, strategic positioning of the HR function, cross-departmental collaboration, communication about digital transformation and support for employee competence development. Rather than focusing exclusively on learning activities, the instrument reflects a holistic understanding of HRM as an organisational system in which digital tools, structures, communication and managerial practices jointly create conditions that may enable or constrain adults' opportunities for learning, experimentation and skill development at work. Following an expert review for content validity, the final scale consisted of 20 statements covering HR domains theoretically relevant to holistic HRM in the digital era, including recruitment and selection, performance appraisal, digital skills and training, digital HR processes, innovation culture, managerial communication, organisational alignment and support for continuous learning. For instance, the item "*Employees have opportunities to apply new technologies in their work*" reflects Rogers' concepts of trialability and observability, which highlight that innovation adoption is more likely when employees can practically test the new tools and observe their benefits.

All items were rated on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). Reliability of the scale was confirmed by high Cronbach's alpha coefficients in both the pilot study ($\alpha = .921$) and the main study ($\alpha = .928$), indicating strong internal consistency (DeVellis, 2017). The high Cronbach's alpha values reflect the systemic and integrative nature of the HHRM 4.0 construct. High internal consistency should therefore be interpreted as conceptual coherence of the instrument, rather than as an indicator of widespread implementation of the measured practices.

The questionnaire was distributed electronically via Google Forms and, in several cases, in hard-copy format, ensuring participant anonymity. Respondents were informed of the purpose of the study and assured that results would be reported only in aggregate form.

Given the ordinal nature of the Likert scale and the non-normal distribution of variables, appropriate non-parametric statistical techniques were applied. In addition, the relatively small sample size and the unequal distribution of respondents across certain subgroups (e.g. gender, ownership structure) further justified the use

of distribution-free tests. Therefore, the Mann–Whitney U and Kruskal–Wallis tests were selected as appropriate procedures for examining group differences. The detailed results of these analyses are presented in the Results section.

Results

Descriptive results for the HHRM 4.0 scale show that mean item scores among HR professionals range from 3.03 to 4.17 on a five-point scale. The highest value was recorded for flexible forms of work ($M = 4.17$), indicating that HR professionals most strongly perceive that employees have opportunities to engage in flexible work arrangements. Relatively high scores were also observed for close cooperation between HR and other departments ($M = 3.84$) and for organisational support for collaboration and knowledge sharing ($M = 3.71$). The lowest mean values were recorded for the use of technology to enhance employee engagement ($M = 3.03$), the use of digital analytics in HR decision-making ($M = 3.04$), the use of KPIs in the context of digitalisation ($M = 3.08$) and the existence of a competence development strategy for digital transformation ($M = 3.03$).

In this study, a mean score of 3.5 was set as the threshold for the sufficient prevalence of a given HHRM element. Because the midpoint of the scale (3) reflects neutrality rather than agreement, this threshold enables a clearer distinction between neutral/negative and explicitly positive perceptions among HR professionals. Based on this criterion, 11 out of 20 items met the threshold, resulting in an Index of Sufficient Prevalence of 55%. Given the predefined criterion of 70%, the findings indicate that holistic HRM cannot be considered sufficiently developed in the organisations included in the sample.

Further analyses examined differences in perceptions of HHRM 4.0 based on the characteristics of HR professionals and the organisations in which they work. Differences between HR managers and HR non-managers were assessed using the Mann–Whitney U test. Significant differences emerged for five items, with HR managers consistently assigning higher scores. Managers perceived more opportunities for employees to apply new technologies at work ($p = .011$), more frequent use of HR digital analytics ($p = .046$), more extensive implementation of digital HR solutions ($p = .026$), stronger organisational support for innovation and experimentation ($p = .007$) and more developed two-way communication between management and employees regarding digital transformation ($p = .044$). These findings point to a perceptual gap within the HR profession, whereby HR managers tend to view digital HR practices more favourably than HR non-managers.

Gender-based differences were also examined using the Mann–Whitney U test. No statistically significant differences were found for 19 out of 20 items ($p > .05$), suggesting that male and female HR professionals generally perceive holistic and digitalised HRM in similar ways. A single significant difference emerged for the use of digital analytics in HR decisions ($p = .038$), with women assigning higher ranks than men. This finding should be interpreted with caution given the substantial gender imbalance in the sample (approximately 85% women).

The role of organisational ownership was explored using the Kruskal–Wallis test among HR professionals employed in foreign-owned, domestic private and public organisations. Ownership structure emerged as a major differentiating factor, with significant differences observed for 18 out of 20 items (all $p < .05$). HR professionals in foreign and domestic private companies consistently reported higher levels of HHRM 4.0 practices, whereas those in public organisations reported notably lower levels. The largest gaps were found in interest in learning new technologies, support for digital skill development, provision of training including AI and automation, opportunities to apply new technologies, the use of HR digital analytics, the implementation of digital HR tools and the application of KPIs in digital contexts. Strong differences were also observed in perceptions of innovation culture, managerial communication and encouragement of employee initiative, with public-sector HR professionals consistently reporting the lowest scores.

Sectoral differences (manufacturing, finance and services) were limited. Only one item—HR strategy's integration of sustainability (ESG)—showed a statistically significant difference ($p = .041$), with the highest scores reported by HR professionals in manufacturing organisations. All other items did not show any significant sector-based differences.

Age-related differences were selective but noteworthy. Statistically significant differences were found in perceptions of support for digital skill development ($p = .032$) and in the provision of digital skills training, including AI and automation ($p = .046$). HR professionals aged 51–55 reported the highest scores in both cases. The lowest scores were reported by the oldest group (56+) for support for digital skill development and by the 31–40 age group for training provision. No statistically significant age differences were observed for the remaining items.

Finally, neither organisational size nor total work experience showed statistically significant effects on HR professionals' perceptions of HHRM 4.0 (all $p > .05$). Variables with highly unbalanced category distributions (HR tenure, organisational tenure and educational level) were not included in group comparisons, as meaningful statistical testing was not feasible.

It should be noted that the high internal consistency of the HHRM 4.0 scale reflects the integrative and systemic nature of the construct rather than the uniform or high-level implementation of its individual elements. Consequently, the relatively modest prevalence index does not contradict the scale's reliability, but rather indicates that while the conceptual domains of holistic HRM 4.0 are clearly defined and coherently measured, their practical implementation across organisations remains uneven.

Discussion

The results of this study show that holistic HRM under Industry 4.0 conditions is only partially developed in the surveyed organisations. An Index of Sufficient Prevalence (ISP) of 55% indicates that nearly half of the examined elements of HHRM 4.0 fall below the threshold for sufficient implementation. Particularly low scores were observed for the use of KPIs in digital HR, the use of HR analytics, the strategic development of digital competences and the implementation of technological solutions aimed at supporting employee engagement. These results suggest that organisations often introduce individual digital tools without embedding them into a broader and strategically coordinated HR architecture. This pattern aligns with the findings of Bhatti and Alqasa (2025), who argue that fragmented implementation of digital systems is one of the most common barriers to successful digital HR transformation.

Similarly, Vidhya Priya and Sundharesalingam (2022) note that organisations in developing economies rarely implement sophisticated HR analytics systems, which is reflected in the present results. These patterns are consistent with broader reviews of technology-driven HRM change, which highlight both opportunities and challenges linked to digitalisation, analytics and automation (Venkateswara Prasad et al., 2024). Focacci et al. (2024) point to a paradox of digitalisation: despite technological progress, organisations often fail to develop processes and metrics that allow digital innovations to generate real organisational value. Zhang and Chen (2023) further argue that successful digital transformation depends on the ability of organisations to integrate technological innovation, strategic HR processes and appropriate employee competences.

The macroeconomic context sheds additional light on these findings. Serbia ranks 72nd out of 141 countries in the World Economic Forum's Global Competitiveness Report (Schwab, 2019), with indicators related to skills and human capital among the weaker ones. This result is consistent with Kayembe and Nel (2019), who show that developing countries often lag in digital adaptation due

to infrastructural, financial and competence constraints. The Digital Serbia Initiative 2025–2027 strategy (Strategija Inicijative „Digitalna Srbija” 2025–2027) stresses the need to develop digital skills, but programmes are predominantly oriented towards formal education, while the needs of employed adults often remain outside the strategy’s focus.

Regarding demographic differences, the results show that gender generally does not have a strong impact on perceptions of digital HR practices, with the exception of digital analytics where women report higher scores ($p = .038$). This finding may be interpreted in light of Li et al. (2008), who show that men and women use new technologies in different ways, with women developing a more detailed understanding of practical applications once they adopt a technology. However, the sample composition (85% women) requires caution in interpretation.

Age has a selective influence: respondents aged 51–55 give the most positive ratings of organisational support and training provision, while the lowest scores are documented among the youngest (31–40) and the oldest (56+) respondents ($p = .032$ and $p = .046$ for the two affected items). This pattern may also reflect generational differences in learning styles and digital preferences. At Thaariq (2023) shows that different generational cohorts engage with learning in distinct ways, suggesting that younger employees may relate to digital solutions differently and, in some cases, evaluate organisational initiatives more critically.

A pronounced gap is evident between HR managers and non-managerial HR staff: managers consistently report higher levels of digital practices on key items related to the application of new technologies, use of digital analytics, implementation of digital HR tools, innovation culture and two-way communication (all $p < .05$). This aligns with the Technology Acceptance Model (Marikyan & Papagiannidis, 2024), according to which perceived usefulness and access to technological resources strongly shape attitudes toward digitalisation. Jovanović and Krasulja (2025) show that deliberately structured continuous professional development within HR teams – such as talent acquisition communities and modular training programmes – strengthens HR professionals’ ability to follow technological change and improve key performance indicators. These findings suggest that those HR roles with greater access to such learning opportunities may also perceive digital transformation more positively.

From an organisational perspective, the strongest differences are observed between the private and public sectors. Domestic and foreign private companies significantly outperform public enterprises in almost all aspects of holistic HRM – from digital skills and training to innovation and two-way communication. This is in line with the European Commission (2024) report, which notes that

the public sector in Serbia is progressing slowly in professionalising the HR function and digitalising processes. Ciancarini et al. (2024) stress that digital transformation in the public sector requires not only technical modernisation, but also deep cultural and institutional changes, including stronger digital competences and greater involvement of IT professionals.

By contrast, sectoral differences are minimal, with the exception of integrating sustainability into HR strategy, where manufacturing companies score higher than financial organisations ($p = .041$). This is consistent with Kalvakolanu and Prasad (2023), who argue that the digital transformation of HR follows a relatively uniform pattern across sectors due to the global standardisation of HR technologies.

Overall, the findings suggest that organisations in Serbia are undergoing partial digital transformation of the HR function: some elements (e.g. flexible work arrangements, cross-functional collaboration) are well developed, while key strategic components – analytics, competence development, innovation culture – remain under-implemented. The results point to the need for systemic, interdisciplinary and andragogically grounded approaches to developing digital competences, as well as for strengthening organisational capacities for integrating technology into HR processes.

Furthermore, the results are consistent with broader European policy frameworks that emphasise continuous upskilling and reskilling of adults as a prerequisite for a resilient and digitally competent workforce. Frameworks such as DigComp 2.2 provide a common language for mapping and developing digital competences across the areas of information and data literacy, communication and collaboration, content creation, safety and problem solving (Vuorikari et al., 2022). Similarly, the European Skills Agenda highlights the need for coordinated efforts by employers, education providers, and policy-makers to design accessible learning opportunities for adults (European Commission, 2020). For organisations, this translates into the task of operationalising these frameworks through context-sensitive workplace learning mechanisms – such as mentoring, peer-to-peer learning, microlearning formats and the use of open and low-cost digital resources – that enable employees to update their skills continuously despite budgetary constraints (Jovanović & Krasulja, 2025). At the same time, the development of digital competences is effective only when combined with transversal skills such as critical thinking, problem solving, collaboration and learning-to-learn, which enable employees to use digital tools in a reflective, responsible and contextually appropriate way, thereby strengthening organisational resilience and capacity for continuous adaptation (European Commission, 2018; OECD, 2021).

Conclusion

The study indicates that elements of holistic human resource management under Industry 4.0 conditions are not yet sufficiently widespread in organisations in Serbia. From an andragogical perspective, the findings primarily contribute to understanding learning within organisations by showing how HRM 4.0 practices shape adults' opportunities for workplace learning and competence development, rather than organisational learning understood as a collective process of knowledge creation. With a prevalence index of 55%, most organisations demonstrate only partial implementation of HHRM 4.0, while key strategic components – such as digital analytics, the use of KPIs, the systematic development of digital competences, and innovation-supportive practices – remain underdeveloped.

The core contribution of this research lies in the use of an author-developed, multidisciplinary instrument that integrates knowledge from HRM, digital transformation, innovation studies and learning in organisations – domains that are inherently connected to adult learning processes. This framework enabled a comprehensive analysis of how organisations conceptualise and enact digital HR practices and how organisational and demographic characteristics shape the perceptions of HR professionals. The results indicate that HR transformation is not only a technical but also an educational process requiring continuous learning, competence development and changes in professional behaviour.

Differences identified between private and public organisations, between HR managers and HR non-managers, and across age groups indicate that digital transformation is uneven and shaped by access to learning opportunities, organisational roles and working conditions. These patterns also have andragogical relevance: they underscore the importance of differentiated learning pathways, tailored competence-development programmes and workplace environments that support adult learning and the transfer of digital skills.

The main limitations of the study relate to the sample structure and the unequal representation of several organisational and demographic categories. Future research should employ larger and more balanced samples, complement quantitative approaches with qualitative methods, and examine longitudinal changes in digital HRM practices and workplace learning.

Despite these limitations, the study offers valuable insights into the current state of holistic HRM in the digital era and highlights the importance of a strategic, integrated and human-centred approach. Organisations that successfully connect technological advancement with learning, competence development and an innovation-oriented culture are more likely to position the HR

function as a key driver of sustainable digital transformation and as a facilitator of meaningful adult learning in the workplace. For adult education and HR development practice, this implies moving beyond isolated training events towards coherent, long-term learning strategies that align workplace learning initiatives with recognised competence frameworks (such as DigComp) and create everyday opportunities for employees to experiment with digital tools, share knowledge and reflect on their learning.

References

- AGUSTONO, D. O. S., NUGROHO, R., & FIANTO, A. Y. A. (2023). Artificial intelligence in human resource management practices. *KnE Life Sciences*, 8(9), 958–970. <https://doi.org/10.18502/kss.v8i9.13409>
- ALLEN, T. D., GOLDEN, T. D., & SHOCKLEY, K. M. (2015). How effective is telecommuting? Assessing the status of our scientific findings. *Psychological Science in the Public Interest*, 16(2), 40–68. <https://doi.org/10.1177/1529100615593273>
- AT THAARIQ, Z. Z. (2023). Learner characteristics based on generational differences. *Journal Pendidikan Humaniora*, 11(1), 10–20.
- BHATTI, M. A., & ALQASA, K. M. A. (2025). Digital integration in human resource management: Role of effective communication, data privacy and information accessibility. *Profesional De La Información*, 34(1), 1–14. <https://revista.profesionaldelainformacion.com/index.php/EPI/article/view/87936>
- CIANCARINI, P., GIANCARLO, R., & GRIMAUDO, G. (2024). Digital transformation in the public administrations: A guided tour for computer scientists. *IEEE Access*, 12, Article 3363075. <https://doi.org/10.1109/ACCESS.2024.3363075>
- DEVELLIS, R. F. (2017). *Scale development: Theory and applications* (4th ed.). SAGE.
- ELKJÆR, B. (2004). Organizational learning: The “third way”. *Management Learning*, 35(4), 419–434.
- EUROPEAN COMMISSION. (2018). *Key competences for lifelong learning: European reference framework*. Publications Office of the European Union. <https://education.ec.europa.eu/document/key-competences-for-lifelong-learning>
- EUROPEAN COMMISSION. (2020). *European Skills Agenda for sustainable competitiveness, social fairness and resilience*. Publications Office of the European Union. <https://ec.europa.eu/social/main.jsp?catId=1223&langId=en>
- EUROPEAN COMMISSION. (2024). Serbia 2024 Report https://enlargement.ec.europa.eu/document/download/3c8c2d7f-bff7-44eb-b868-414730cc5902_en?filename=Serbia%2520Report%25202024.pdf
- FELDMAN, D., & NG, T. (2021). Participation in continuing education programs: Antecedents, consequences and implications. In M. London (Ed.), *The Oxford handbook of lifelong learning* (2nd ed., pp. 347–366). Oxford University Press.

- FOCACCI, C. N., PICHULT, F., & RONDEAUX, G. (2024). Managers in the era of digital transformation: Navigating the dual realities of time. *New Technology, Work and Employment*, 1–10. <https://doi.org/10.1111/ntwe.12320>
- HASAN, M., HAQUE, M. A., NISHAT, S., & HOSSAIN, M. M. (2024). Upskilling and reskilling in a rapidly changing job market: Strategies for organizations to maintain workforce agility and adaptability. *European Journal of Business and Management Research*, 9(6), 2502. <https://doi.org/10.24018/ejbmr.2024.9.6.2502>
- HININGS, B., GEGENHUBER, T., & GREENWOOD, R. (2018). Digital innovation and transformation: An institutional perspective. *Information and Organization*, 28(1), 52–61. <https://doi.org/10.1016/j.infoandorg.2018.02.004>
- ILLERIS, K. (2018). *Contemporary theories of learning*. Taylor & Francis.
- DIGITAL SERBIA INITIATIVE. (2024). “Digital Serbia” Initiative strategy 2025–2027: Unlocking the next level of [Presentation]. <https://www.dsi.rs/wp-content/documents/DIGITAL-SERBIA-INITIATIVE-STRATEGY-2025–2027.pdf>
- JOVANOVIĆ, T. P., & KRASULJA, N. D. (2025). Enhancing talent acquisition through lifelong learning: A case study. *Inovacije u nastavi*, XXXVIII(1), 120–132.
- KALVAKOLANU, S., & PRASAD, K. (2023). Human resource management digitalization. *International Review*, 3–4, 163–171. <https://doi.org/10.5937/intrev2304160K>
- KANE, G. C., PALMER, D., PHILLIPS, A. N., KIRON, D., & BUCKLEY, N. (2015). Strategy, not Technology, Drives Digital Transformation: Becoming a Digitally Mature Enterprise. <http://sloanreview.mit.edu/projects/strategy-drives-digital-transformation/>
- KAYEMBE, C., & NEL, D. (2019). Challenges and opportunities for education in the Fourth Industrial Revolution. *African Journal of Public Affairs*, 11(3), 79–94.
- LI, S., GLASS, R., & RECORDS, H. (2008). The Influence of Gender on New Technology Adoption and Use—Mobile Commerce. *Journal of Internet Commerce*, 7(2), 270–289.
- MARIKYAN, D., & PAPAGIANNIDIS, S. (2024). Technology Acceptance Model: A review. In S. Papagiannidis (Ed.), *TheoryHub Book*. <https://open.ncl.ac.uk> / ISBN: 9781739604400
- MEIJERINK, J., BOONS, M., KEEGAN, A., & MARLER, J. (2021). Algorithmic human resource management: Synthesizing developments and cross-disciplinary insights on digital HRM. *The International Journal of Human Resource Management*, 32(12), 2545–2562. <https://doi.org/10.1080/09585192.2021.1925326>
- OECD. (2021). *Skills for a 21st century: OECD Learning Compass 2030*. OECD Publishing. <https://www.oecd.org/en/data/tools/oecd-learning-compass-2030.html>
- POÓR, J., SLAVIĆ, A., TÓTH, K., BERBER, N., & KERÉKES, K. (2020). Benchmarking in human resource management in focus of Central and Eastern Europe in the light of CRANET research. *Strategic Management*, 25(1), 21–28. <https://doi.org/10.5937/StraMan2001021P>
- RAVICHANDRAN, T. (2018). Exploring the relationships between IT competence, innovation capacity and organizational agility. *The Journal of Strategic Information Systems*, 27(1), 22–42. <https://doi.org/10.1016/j.jsis.2017.07.002>
- ROGERS, E. (2003). *Diffusion of innovations* (5th ed.). Free Press.

- SCHWAB, K. (2017). *The fourth industrial revolution*. Crown Publishing.
- SCHWAB, K. (2019). *The Global Competitiveness Report 2019*. World Economic Forum.
- STROHMEIER, S. (2020). Digital human resource management: A conceptual clarification, *German Journal of Human Resource Management*, 34(3), 345–365.
- VENKATESWARA PRASAD, B., YOUNUS HAMRAAIA, M. H., SHARMA, B. C., & PEREIRA, C. S. (2024). The impact of technology on human resource management: Trends and challenges. *Educational Administration: Theory and Practice*, 30(5), 9746–9752. <https://doi.org/10.53555/kuey.v30i5.4635>
- VIDHYA PRIYA, P., & SUNDHARESALINGAM, P. (2022). Impact of Industry 4.0 on Human Resource Process. *Ushus Journal of Business Management*, 21(2), 41–56. <https://doi.org/10.12725/ujbm.59.4>
- VUORIKARI, R., KLUZER, S., & PUNIE, Y. (2022). *DigComp 2.2: The Digital Competence Framework for Citizens – With new examples of knowledge, skills and attitudes*. European Commission, Joint Research Centre.
- WESTERMAN, G., CALMÉJANE, C., BONNET, D., FERRARIS, P., & MCAFEE, A. (2011). *Digital Transformation: A Roadmap for Billion-Dollar Organizations*. MIT Center for Digital Business and Capgemini Consulting.
- ZHANG, J., & CHEN, Z. (2023). Exploring human resource management digital transformation in the digital age. *Journal of the Knowledge Economy*, 15, 1482–1498. <https://doi.org/10.1007/s13132-023-00445-5>