

THE USE OF INTELLIGENT TECHNOLOGIES IN HUMAN RESOURCE MANAGEMENT AND THEIR RELATIONSHIP WITH HRM FUNCTIONS

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Abstract

The digitalization and development of intelligent technologies increasingly affect human resource management, yet empirical evidence on how specific technologies relate to individual HRM functions remains limited, particularly in Central and Eastern Europe. This study aimed to examine relationships between the use of selected intelligent technologies (artificial intelligence, Big Data, the Internet of Things, and virtual reality) and the level of HRM functions in organizations. Data were collected through a questionnaire survey of 150 HR managers from medium-sized and large enterprises operating in Slovakia, using a five-point Likert scale. Relationships were analyzed using Spearman's correlation coefficient with Benjamini–Hochberg (FDR) correction; statistical analyses were conducted in SPSS and visualized via correlation heatmaps in R. The results revealed statistically significant positive relationships between all examined technologies and HRM functions, with the strongest associations for Big Data and weaker but consistent relationships for virtual reality. The study contributes by identifying technological areas most closely linked to HRM functions in Slovak enterprises, while its limitations include the cross-sectional design, national focus, and the inability to infer causality.

Key words:

functions of human resource management, HR managers, AI, BD, IOT, VR

JEL Classification M12, O15, O33

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INTRODUCTION

Rapid technological progress and the increasing deployment of intelligent technologies are fundamentally transforming organizational operations and management practices. In an environment characterized by technological change, globalization, and intensified competition, effective human resource management (HRM) plays an increasingly important role in supporting organizational performance and long term sustainability (Body et al., 2024). Digital transformation, commonly associated with the Fourth Industrial Revolution, has been identified as a key driver of changes in HRM, prompting organizations to reconsider how HR activities are designed and delivered (Van den Berg et al., 2020). Digital technologies influence multiple HR related processes across the employee lifecycle, including recruitment, training, performance management, and workforce planning. The adoption of tools such as artificial intelligence, Big Data analytics, and other digital solutions enables organizations to enhance efficiency, improve decision making, and

strengthen their competitive position (Kholod et al., 2021). At the same time, the extent and nature of technology adoption in HRM vary across organizational and national contexts. Empirical evidence indicates that while digital HR tools are widely implemented in many organizations, differences exist in the pace and depth of adoption, often shaped by external conditions and contextual factors (Ulatowska et al., 2023). Although the importance of intelligent technologies for HRM is widely acknowledged, their integration into HR processes remains uneven, and organizations differ in how they leverage specific technologies to support HRM activities. Understanding these patterns is essential for advancing knowledge on digital HRM and for supporting informed managerial decision making in organizations operating in increasingly digital environments.

1. LITERATURE OVERVIEW

Human resource management is commonly defined as a systematic approach to managing and developing people in organizations, based on the assumption that HR practices significantly

influence organizational performance (Armstrong & Taylor, 2014). In the literature, HRM is frequently conceptualized through HRM functions, which translate HRM principles into structured areas of organizational practice and enable the assessment of HRM activities in a consistent manner (Patrick & Mazhar, 2019). HRM functions cover core activities across the employee lifecycle, including planning, staffing, performance management, employee experience, well-being, rewards, development, internal mobility, job design, and HR administration (Alkalha et al., 2012; Koopmans et al., 2014; Havenga et al., 2013; Weziak-Białowolska et al., 2022). A comprehensive functional framework comprising twelve HRM functions has been proposed by Deepa et al. (2024)

Artificial intelligence is frequently discussed as a technology capable of supporting automation and decision-making in HR processes. Existing literature highlights the potential of AI to improve HR efficiency and contribute to organizational productivity. However, research also points to a lack of comprehensive frameworks guiding the strategic adoption of AI in HRM (Malik et al., 2023). In addition, ethical considerations related to transparency, data privacy, and fairness remain prominent concerns in the application of AI within HR contexts (Varma et al., 2023). These aspects suggest that AI may be associated with various HRM functions, particularly those involving evaluation and decision support.

Big Data has emerged as a core element of data driven management and is often regarded as a critical investment for maintaining organizational competitiveness. Prior research indicates that Big Data analytics can enhance organizational and HR performance when analytical capabilities are aligned with appropriate organizational conditions (Mikalef et al., 2019). Empirical studies also demonstrate the applicability of advanced analytics and machine learning in HR related decisions, such as promotion modelling and leadership identification (Gülten & Baraçlı, 2024). These findings suggest a strong link between Big Data utilization and the perceived effectiveness of HRM functions.

The Internet of Things enables continuous data collection through interconnected devices

and systems and has been associated with process optimization in organizational environments. In HRM contexts, IoT applications may support workplace monitoring, compliance, and risk management, while also introducing new challenges related to data governance and integration (Abdussamad et al., 2022). Research further suggests that linking IoT data with HR analytics can contribute to improved resource utilization and working conditions (Podder et al., 2024), indicating potential connections between IoT usage and HRM function performance.

Virtual reality has gained attention as a technology applicable to HRM activities such as recruitment, onboarding, training, and the communication of organizational culture. Several studies argue that VR can support the transition toward digital HRM by offering immersive and interactive solutions (Svatiuk et al., 2022; Lai et al., 2023). Research in training contexts reports positive effects on motivation and engagement, although findings also suggest that the benefits of VR are not always consistent across applications and settings (Yudintseva, 2023). This positions VR as a developing technology with varying relevance across HRM functions.

The reviewed literature demonstrates that intelligent technologies including AI, BD, IoT, and VR are increasingly integrated into HRM and may support a wide range of HR related activities. However, existing studies often focus on individual technologies or specific HR applications and provide limited empirical evidence on how the utilization of particular technologies relates to the perceived level of specific HRM functions. Moreover, research examining these relationships in the context of Slovak medium-sized and large organizations remains scarce. Therefore, the objective of this study is to identify relationships between the use of selected intelligent technologies and the level of individual human resource management (HRM) functions in organizations. Specifically to identify relationships between the use of selected intelligent technologies (AI, Big Data, IoT, and VR) and the level of HRM functions as perceived by HR managers in medium-sized and large enterprises operating in Slovakia. By applying correlation analysis, the study aims to

determine which technologies are most strongly associated with HRM function levels.

2. GOAL AND METHODOLOGY

The main objective of the research was to examine relationships between the use of selected intelligent technologies and the level of individual human resource management (HRM) functions in organizations. The research focuses on identifying specific intelligent technologies in relation to HRM functions, rather than examining causal effects. Based on the gap and the aim of the study, a research question was set. RQ: What relationships exist between the use of selected intelligent technologies and the level of HRM functions in organizations?

Data were collected through a questionnaire survey conducted among HR managers working in medium-sized and large enterprises operating

in Slovakia. A total of 150 valid questionnaires were obtained and included in the analysis. The respondents were HR managers responsible for human resource management functions within their organizations, which ensured the relevance and reliability of the collected data.

Respondents assessed the extent of use of intelligent technologies in the field of human resource management, namely artificial intelligence (AI), big data (BD), Internet of Things (IoT) and virtual reality (VR), as well as the level of performance of twelve selected HRM functions. All items were measured using a five-point Likert scale, where higher values indicated a higher degree of use of technologies or a higher level of perceived performance of the HRM function. Table 1 presents the variable codes used in the study and their corresponding descriptions.

Table 1: Codes of variables

Code	Variable description
AI	Artificial intelligence
IOT	Internet of Things
BD	Big Data
VR	Virtual reality
HRMF1	Workforce planning
HRMF2	Recruitment
HRMF3	Employee selection
HRMF4	Performance appraisal
HRMF5	Employee experience management
HRMF6	Employee engagement support
HRMF7	Employee health and well-being support
HRMF8	Compensation management
HRMF9	Training and development
HRMF10	Internal mobility and career progression
HRMF11	Job design
HRMF12	Employee self-service management

Source: author's processing

Data analysis was conducted using both SPSS and R software. Descriptive statistics, including mean values and standard deviations, were used to describe the basic characteristics of the research variables. Given the ordinal nature of the Likert-scale data, Spearman's rank correlation coefficient (ρ) was applied to analyze the relationships between the use of intelligent technologies and the level of HRM functions. The strength of Spearman's rank correlation coefficients was interpreted based on absolute values, with coefficients below 0.10 considered

negligible, values between 0.10 and 0.39 weak, 0.40 to 0.69 moderate, 0.70 to 0.89 strong, and values of 0.90 or higher indicating very strong correlations (Schober, et al. 2018).

To control for the increased risk of false-positive results due to multiple testing, the Benjamini–Hochberg procedure for controlling the false discovery rate (FDR) was applied. The results of the correlation analysis were visualized using a correlation heatmap created in the R environment, which enabled a clear and

comprehensive presentation of the strength and direction of the identified relationships.

Participation in the survey was voluntary and anonymous. The study is subject to certain limitations. The research focuses exclusively on organizations operating in Slovakia, which may limit the generalizability of the findings. Furthermore, the cross-sectional nature of the study and the use of self reported data allow for the identification of relationships between variables, but not for the determination of causal effects.

3. FINDINGS

This section presents the empirical findings of the study based on the analysis of data collected from HR managers in medium-sized

and large organizations operating in Slovakia. The results include descriptive statistics of the analyzed variables and the outcomes of the correlation analysis examining relationships between the use of selected intelligent technologies and the level of HRM functions. Spearman's rank correlation coefficients were applied to identify the strength and direction of associations between variables. The findings are presented in tabular form and supported by graphical visualization using a correlation heatmap.

3. 1 Descriptive statistics

Table 2 presents the descriptive statistics of the analyzed variables. The sample consisted of 150 respondents for all variables.

Table 2: Descriptive statistics of the analyzed variables

	N	Minimum	Maximum	Mean	Std. Deviation
AI	150	1	5	3.30	.911
IOT	150	1	5	3.39	1.008
BD	150	1	5	3.61	.952
VR	150	1	5	3.19	1.139
HRMF1	150	1	5	3.80	.801
HRMF2	150	1	5	3.81	.906
HRMF3	150	1	5	3.77	.878
HRMF4	150	1	5	3.79	.835
HRMF5	150	1	5	3.88	.802
HRMF6	150	1	5	3.88	.850
HRMF7	150	1	5	3.83	.943
HRMF8	150	1	5	3.72	.996
HRMF9	150	1	5	3.79	.880
HRMF10	150	1	5	3.73	.879
HRMF11	150	1	5	3.67	.830
HRMF12	150	1	5	3.77	.785

Source: author's processing (SPSS)

The mean values for the use of intelligent technologies ranged from 3.19 to 3.61 on a five-point Likert scale. Among the analyzed technologies, Big Data showed the highest mean value ($M = 3.61$; $SD = 0.952$), followed by Internet of Things ($M = 3.39$; $SD = 1.008$) and artificial intelligence ($M = 3.30$; $SD = 0.911$). Virtual reality achieved the lowest mean value ($M = 3.19$; $SD = 1.139$), indicating a comparatively lower level of utilization.

The mean values of HRM functions ranged from 3.67 to 3.88, suggesting a generally high perceived level of HRM function performance across the analyzed organizations. The highest

mean values were observed for HRMF5 and HRMF6 (both $M = 3.88$), while the lowest mean value was recorded for HRMF11 ($M = 3.67$). Standard deviations indicate moderate variability in respondents' assessments.

3. 2 Correlation analysis of intelligent technologies and HRM functions

Spearman's rank correlation coefficient was used to examine the relationships between the use of intelligent technologies and the level of HRM functions. The results of the correlation analysis are presented in Table 3. Statistical significance was evaluated using p-values, with

results considered statistically significant at $p < 0.05$. All identified correlations were positive and statistically significant at the 0.001 significance level ($p < 0.001$). The results

remained statistically significant after applying the Benjamini–Hochberg correction for multiple testing.

Table 3: Spearman's rank correlation

		AI	IOT	BD	VR
HRMF1	Correlation Coefficient	.407***	.477***	.561***	.375***
	Sig. (2-tailed)	<.001	<.001	<.001	<.001
	N	150	150	150	150
HRMF2	Correlation Coefficient	.444***	.412***	.535***	.375***
	Sig. (2-tailed)	<.001	<.001	<.001	<.001
	N	150	150	150	150
HRMF3	Correlation Coefficient	.412***	.351***	.512***	.400***
	Sig. (2-tailed)	<.001	<.001	<.001	<.001
	N	150	150	150	150
HRMF4	Correlation Coefficient	.478***	.435***	.540***	.409***
	Sig. (2-tailed)	<.001	<.001	<.001	<.001
	N	150	150	150	150
HRMF5	Correlation Coefficient	.303***	.353***	.499***	.295***
	Sig. (2-tailed)	<.001	<.001	<.001	<.001
	N	150	150	150	150
HRMF6	Correlation Coefficient	.357***	.421***	.498***	.331***
	Sig. (2-tailed)	<.001	<.001	<.001	<.001
	N	150	150	150	150
HRMF7	Correlation Coefficient	.339***	.407***	.481***	.378***
	Sig. (2-tailed)	<.001	<.001	<.001	<.001
	N	150	150	150	150
HRMF8	Correlation Coefficient	.381***	.416***	.504***	.348***
	Sig. (2-tailed)	<.001	<.001	<.001	<.001
	N	150	150	150	150
HRMF9	Correlation Coefficient	.404***	.395***	.517***	.309***
	Sig. (2-tailed)	<.001	<.001	<.001	<.001
	N	150	150	150	150
HRMF10	Correlation Coefficient	.478***	.500***	.580***	.412***
	Sig. (2-tailed)	<.001	<.001	<.001	<.001
	N	150	150	150	150
HRMF11	Correlation Coefficient	.413***	.397***	.483***	.420***
	Sig. (2-tailed)	<.001	<.001	<.001	<.001
	N	150	150	150	150
HRMF12	Correlation Coefficient	.392***	.439***	.541***	.363***
	Sig. (2-tailed)	<.001	<.001	<.001	<.001
	N	150	150	150	150

*** Correlation is significant at the 0.001 level (2-tailed).

Source: author's processing (SPSS)

Artificial intelligence exhibited predominantly weak to moderate positive correlations with HRM functions. Weak correlations were observed for several HRM functions (e.g., HRMF5, $\rho = 0.303$), while moderate correlations were identified for HRMF4 and HRMF10 (both $\rho = 0.478$).

Similarly, the Internet of Things demonstrated weak to moderate positive relationships with HRM functions, with correlation coefficients ranging from weak

associations ($\rho = 0.351$ for HRMF3) to moderate associations ($\rho = 0.500$ for HRMF10).

Virtual reality showed mainly weak positive correlations across HRM functions, with correlation coefficients ranging from $\rho = 0.295$ (HRMF5) to $\rho = 0.420$ (HRMF11). Only a limited number of relationships reached the moderate correlation level.

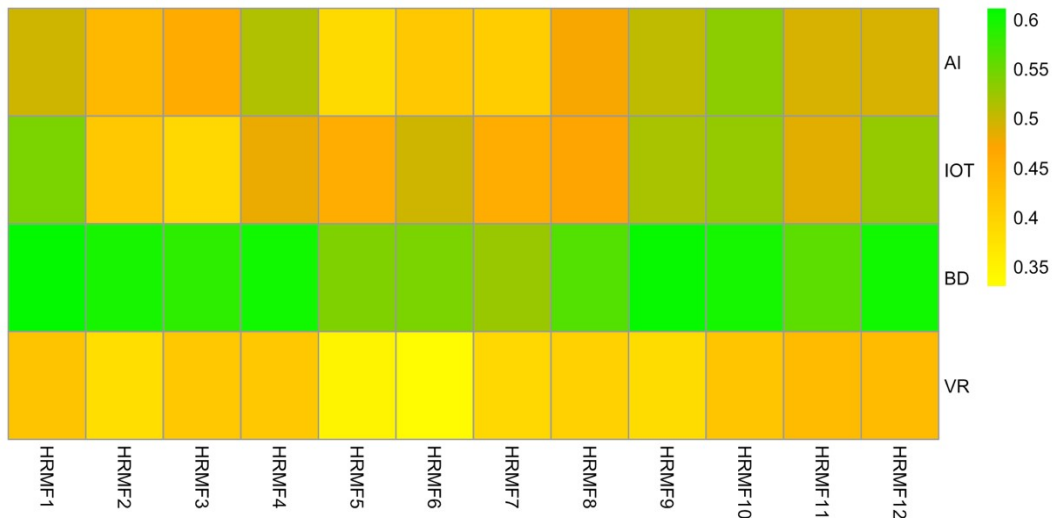
In contrast, Big Data displayed consistently moderate positive correlations with all analyzed HRM functions. Correlation coefficients ranged

from $\rho = 0.481$ (HRMF7) to $\rho = 0.580$ (HRMF10), indicating stable and comparatively stronger associations than those observed for the other technologies. Moderate correlations were identified across all HRM functions, with higher values particularly evident for HRMF1, HRMF4, HRMF9, HRMF10, and HRMF12.

3. 3 Correlation heatmap of intelligent technologies and HRM functions

To facilitate a comprehensive overview of the identified relationships, the correlation matrix was visualized using a correlation heatmap (Figure 1), which was created in the R software environment.

Figure 1 Heatmap of correlations



Source: author's processing

The heatmap illustrates clear differences in the strength of associations across technologies, with Big Data displaying consistently higher correlation values across all HRM functions. Artificial intelligence and Internet of Things show moderate patterns of association, while virtual reality demonstrates comparatively lower correlation intensities. The visualization supports the numerical results presented in Table 3 and highlights the relative dominance of Big Data in relation to HRM functions.

4. DISCUSSION

The aim of the paper was to examine relationships between the use of selected intelligent technologies and the level of individual human resource management (HRM) functions in organizations. In line with the RQ1 “What relationships exist between the use of selected intelligent technologies and the level of HRM functions in organizations?”, the findings confirm that statistically significant positive associations exist between all analyzed

intelligent technologies and HRM functions, although the strength of these relationships differs across technologies.

The strongest and most consistent relationships were observed for Big Data across nearly all HRM functions. Moderate associations were identified particularly for workforce planning (HRMF1), recruitment (HRMF2), performance appraisal (HRMF4), internal mobility and career progression (HRMF10), and employee self-service management (HRMF12). These functions are inherently data intensive and rely on systematic information processing, which aligns with existing literature emphasizing the role of Big Data analytics in supporting evidence based HR decision making and HR process optimization (Mikalef et al., 2019; Verma et al., 2021). Prior studies demonstrating the applicability of analytics and machine learning in promotion decisions and workforce evaluation further support the observed associations with

performance appraisal and career related HRM functions (Gülten & Baraçlı, 2024).

Artificial intelligence exhibited weaker to moderate relationships with HRM functions, with relatively stronger associations identified for recruitment (HRMF2), performance appraisal (HRMF4), training and development (HRMF9), internal mobility and career progression (HRMF10), and job design (HRMF11). These findings correspond with prior research describing AI in HRM as a technology primarily applied in selected HR areas, particularly those involving automation, screening, and decision support, rather than across all HRM functions uniformly (Malik et al., 2023). Ethical and implementation related concerns discussed in the literature may partially explain why AI adoption remains uneven across HRM functions, especially those requiring human judgment and interpersonal interaction (Varma et al., 2023).

The Internet of Things demonstrated predominantly weak to moderate associations with HRM functions, with comparatively higher correlations observed for workforce planning (HRMF1), employee health and well-being (HRMF7), internal mobility and career development (HRMF10), job design (HRMF11), and employee self-service management (HRMF12). These results align with studies highlighting IoT applications in workplace monitoring, environmental optimization, and support of employee related administrative processes (Abdussamad et al., 2022; Podder et al., 2024). The findings suggest that IoT technologies may be more closely linked to HRM functions associated with the work environment and operational support rather than strategic HR activities.

Virtual reality showed the weakest, though still statistically significant, associations across HRM functions. Slightly stronger relationships were observed for employee selection (HRMF3), performance appraisal (HRMF4), internal mobility and career progression (HRMF10) and job design (HRMF11). This pattern is consistent with previous research indicating that VR is mainly utilized in specific HR contexts, such as recruitment, onboarding, and training, where immersive technologies can enhance engagement and experiential learning (Svatiuk et al., 2022; Lai et al., 2023; Yudintseva, 2023). The

relatively low correlation values suggest that VR remains a complementary rather than a core technology within HRM practices in the analyzed organizations.

However, several findings of this study diverge from conclusions emphasized in existing literature. While prior studies frequently portray artificial intelligence and virtual reality as strategically transformative technologies for HRM, the present results indicate only weak to moderate associations between AI and most HRM functions and comparatively weaker associations for VR across the analyzed functions. This contrasts with research highlighting the central role of AI in enhancing HR productivity and decision making and the growing importance of VR in recruitment, training, and organizational culture development (Malik et al., 2023; Svatiuk et al., 2022; Lai et al., 2023). The weaker relationships observed in this study suggest that, within the Slovak medium-sized and large enterprise context, these technologies may still be implemented selectively rather than systematically across HRM functions. In contrast to conceptual and future oriented studies, the findings indicate that data driven technologies such as Big Data currently play a more prominent and consistently embedded role in HRM practice, whereas immersive and AI based solutions remain at an earlier stage of integration.

Overall, the findings demonstrate that intelligent technologies are not uniformly associated with all HRM functions. Data driven technologies, particularly Big Data, show stronger and more consistent relationships with HRM functions compared to emerging and immersive technologies such as VR. This supports the view that digital HRM development is incremental and function specific, reflecting differences in technological maturity, applicability, and organizational readiness. From a practical perspective, the results suggest that organizations aiming to strengthen HRM functions may benefit from prioritizing analytics oriented technologies while adopting other intelligent technologies selectively based on functional relevance.

CONCLUSION

This study addressed the growing relevance of intelligent technologies in human resource management by examining relationships between selected technologies and HRM functions. The objective was to examine associations between intelligent technologies and the level of HRM functions using data collected from 150 HR managers in medium-sized and large organizations in Slovakia. Spearman's rank correlation analysis revealed statistically significant positive relationships across all technologies, with Big Data showing the strongest and most consistent associations with HRM functions, particularly those related to planning, recruitment, development, and career progression. The findings indicate that data driven technologies are currently more closely aligned with HRM function maturity than emerging and immersive technologies such as AI and VR, which appear to be applied more

selectively. The study is limited by its cross-sectional design and national scope and by the use of correlation analysis, which does not allow causal inference. Despite these limitations, the results contribute empirical evidence to the digital HRM literature and provide practical insights for organizations seeking to prioritize technology adoption in HRM. Future research should focus on longitudinal analyses, cross country comparisons, and function specific investigations to further explore technology and HRM relationships.

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