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FACTORS INFLUENCING ERP SYSTEM USAGE IN MANUFACTURING AND SERVICE INDUSTRIES: A COMPARATIVE STUDY USING PLS-SEM AND fsQCA

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Abstract

Enterprise Resource Planning (ERP) systems represent an important technological infrastructure for enhancing operational efficiency and strategic decision making in various industries. This study examines the key determinants influencing the adoption of ERP systems, with a particular focus on organizations operating in the manufacturing and service sectors in the Western Balkans region. In order to empirically evaluate the proposed conceptual framework, Partial Least Squares Structural Equation Modeling (PLS-SEM) and Fuzzy Set Qualitative Comparative Analysis (fsQCA) were employed. In this way, both linear relationships and configuration pathways underlying ERP implementation behavior were captured. The results of the PLS-SEM analysis show that constructs such as work compatibility, perceived usefulness and external factors are statistically significant predictors of users' attitudes towards using ERP systems. In addition, a significant relationship was found between attitude and actual use of ERP systems, with user experience serving as a moderating variable. Notably, the multi-group analysis revealed no significant differences in intentions, attitudes or preferences between users from the manufacturing and service sectors. The results of the fsQCA study also show that work compatibility and perceived usefulness are the core present conditions necessary for effective ERP adoption. This study contributes to the existing literature by integrating multiple analytical approaches to explore the complexity of ERP usage. Additionally, it provides practical insights for enterprise managers, ERP vendors and policymakers.

Keywords: ERP system, manufacturing sector, service sector, PLS-SEM, fsQCA

1. INTRODUCTION

In today's business environment, which is characterized by strong competitive pressure, there is a need to react quickly and digitize numerous business processes (Adu

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et al., 2022; Pech & Vaněček, 2022). Information technology-based systems, such as Enterprise Resource Planning (ERP), have emerged as the main solution to these swiftly changing environmental conditions. ERP is a centralized computer system that integrates all business transactions of the company to serve different departments simultaneously (Lee & Kim, 2016). This system acts as the main link that stores, shares and transmits information across all business functions (Putri et al., 2020), thus acting as the backbone of the organization. Before the introduction of the ERP system, up-to-date information was not accessible in all areas of the company (Deranek et al., 2019). The implementation of an ERP system leads to improved material flows, standardization of business processes, accuracy and improved cross-functional integration (Mabert et al., 2003; Chopra et al., 2022). In addition, ERP improves internal and external communication while increasing efficiency and effectiveness by automating traditional manual processes (Althunibat et al., 2019). It provides greater transparency and enables employees to respond more quickly (Maas et al., 2014). The main feature of an ERP system is therefore business integration (Abu Afifa et al., 2023; Chernova et al., 2023). As far as future forecasts are concerned, the ERP market in Europe is expected to grow considerably in the coming years. The increasing demand for this software is driven by the need for efficient business processes. As a result, market revenue is expected to reach USD 0.87 billion by the end of 2025 (Statista, 2025). Some studies indicate that the adoption and use of business information systems has been widely researched in developed countries, while research in developing countries lags behind (Baker et al., 2010). However, in the Western Balkan countries (WBC), a region consisting mainly of developing countries, ERP applications are being adopted slowly or not at all, especially in small and medium-sized enterprises. Ilin et al. (2017) found that developing countries in the WBC have significantly less financial resources to implement ERP systems compared to developed countries, yet they are trying to keep up with technological trends. Therefore, it is crucial to carefully evaluate the digitalization of companies in this region.

Although the costs of ERP implementation are relatively high (Ranjan et al., 2016), the benefits are considerable. Therefore, every company tends to maximize ERP usage, which depends on user attitudes towards ERP. Companies often assess employee beliefs, attitudes and behaviors. A robust approach to measuring the acceptance of new information systems such as ERP is the Technology Acceptance Model (TAM). In numerous studies (Brandon-Jones & Kauppi, 2018; Meyliana et al., 2018; Uddin et al., 2020; Hancerliogullari Koksalmis & Damar, 2022), the TAM has often shown predictive power in explaining the acceptance of ERP systems.

In light of these considerations, this study aims to deepen the understanding of the current state of ERP adoption among manufacturing and service companies in the Western Balkans. This paper aims to examine the key factors influencing ERP utilization. To analyze the proposed hypotheses, Partial Least Squares Structural Equation Modeling (PLS-SEM) is used in this study. To explore potential differences between manufacturing and service companies, a Multi-Group Analysis (MGA) was conducted, along with an additional investigation of users' level of experience

with ERP as a moderating factor. This approach allows testing whether the structural relationships within the proposed model differ significantly between the two sectors, providing a more nuanced understanding of ERP adoption patterns in the different types of companies. In addition to the PLS-SEM method, the study applies fuzzy-set Qualitative Comparative Analysis (fsQCA) as a complementary method. The fsQCA enables the identification of combinations of conditions that lead to high levels of ERP adoption and usage. This method is valuable in uncovering causal complexity and gaining insights that are not possible with traditional statistical approaches, especially in developing regions such as the Western Balkans. By combining these advanced analytical techniques, the study offers a comprehensive methodological framework that captures both linear and configurational effects, ensuring a robust and multidimensional understanding of ERP adoption in the WBC region.

The rest of the article is organized as follows. The literature review consists of subsections devoted to bibliometric analysis and hypothesis development. The research methodology outlines the methods and techniques used in this study. Results section presents the key findings of the applied methodology. The discussion section addresses the main research findings and compares them with those of similar studies. Finally, the conclusion highlights the theoretical and practical implications, limitations of the study and recommendations for future research approaches.

2. LITERATURE REVIEW

The literature review is divided into several subsections, which are important for the comprehensive analysis. It begins with a bibliometric analysis aimed at identifying patterns and trends in the existing literature. It then continues with to the theoretical background and the development of hypotheses that lead to a proposed research model.

2.1. Bibliometric analysis

The recognition of the growing importance of ERP systems has led to an increase in scientific work on this topic. However, there are still only a limited number of publications dealing with this topic. To highlight the need for further research on ERP systems, a bibliometric analysis is also conducted in this study. The research method used in this study followed the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines. The PRISMA approach offers a standardized methodology that guarantees the quality of literature reviews (Page et al., 2021). Data were collected from the Web of Science, Science Direct and Scopus databases using the keywords ”ERP system”, ”TAM” and ”Users” for the last twenty years (01/01/2005-01/01/2025). Figure 1 shows the PRISMA flowchart diagram, which illustrates the stages of identification, screening and inclusion.

In the first phase, a total of 71 papers were found, 62 of them from the Web of Science database and 9 from Science Direct. After removing duplicates (n = 8), records marked as irrelevant by automated tools (n = 4), and records removed for other reasons (n = 4), 55 papers remained for analysis. During

screening based on titles and abstracts, 3 papers were excluded, leaving 52 papers for further assessment. A further 7 studies were excluded after further analysis – five because they focused on other systems and two because they focused on higher education rather than the industrial context. In the end, a total of 45 studies met all the specified criteria.

In addition, an analysis was carried out in which the new keyword "Western Balkans" was added to the keywords already in use, but no entries were found that matched these keywords. This suggests that this topic is somewhat overlooked or neglected in this geographical area.

From the bibliometric review, it can be concluded that the adoption of ERP systems is poorly researched, as evidenced by the limited number of publications. Furthermore, developing countries, such as the Western Balkan countries, should be more involved in research on this particular topic as they can contribute to the current literature. Considering all these points, this study aims to extend the literature by examining the attitudes of ERP users in a specific regional context, following the model of customized ERP adoption.

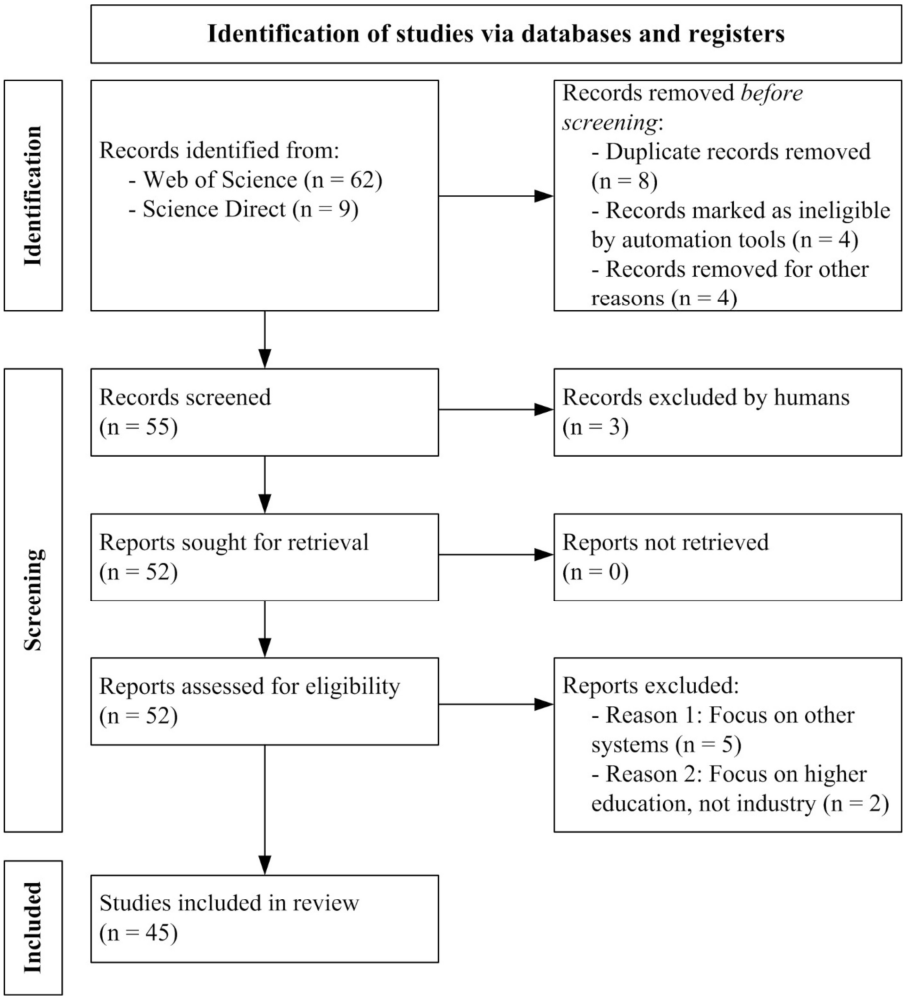

Figure 1. PRISMA flow-chart

2.2. Hypotheses development

The Technology Acceptance Model (TAM) introduced by Davis (1989) explains how users accept and use information systems. This model remains one of the fundamental frameworks for evaluating the acceptance of new technologies (Singh & Chakraborty, 2024). Over time, the TAM has evolved into an extended version and has been studies in research areas related to ERP systems. The acceptance and utilization of the new ERP system depend on various constructs. According to the research of Sternad Zabukovšek et al. (2019), the extended TAM includes several constructs: Work Compatibility, elements of the original TAM (Perceived Ease of Use, Perceived Usefulness) and External Factors (Business Process Fit, System Complexity, Social Influence, System Performance, User Manuals).

Work Compatibility (WC) describes how effectively the technology supports users in completing business tasks (Tarik et al., 2020). Research shows that WC is a key factor influencing attitudes towards the adoption of new technologies (Sun et al., 2009). When an ERP system aligns with organizational tasks, resistance to change decreases during implementation, which promotes a positive attitude towards ERP use (Xu et al., 2017). This factor is often seen as an essential prerequisite for ERP adoption (Lutfi et al., 2022). Based on this, hypothesis H1 is formulated as follows:

H1. Work Compatibility of the ERP system positively impacts Attitude to Use.

Perceived Usefulness (PU) refers to users' subjective assessment of how using the ERP system in business activities improves job performance (Lee & Kim, 2016; Jo & Bang, 2023). PU can also be described as the users' belief that the new technology increases efficiency in routine tasks and improves quality (Putri et al., 2020). Perceived Ease of Use (PEoU) refers to how much users expect that the ERP can be operated effortlessly (Lee & Kim, 2016). Another description in the literature describes PEoU as the belief that using the ERP system makes task fulfilment easier (Putri et al., 2020). Al-Jabri & Roztocki (2015) studied TAM in various industry sectors, including manufacturing and services, and found that both PU and PEoU are statistically significant predictors of users' attitudes towards ERP. Yasar & Ozer (2016) used factor analysis and correlation analysis to examine various service and manufacturing industries and found that both PU and PEoU have a statistically significant relationship with ERP utilization. Putri et al. (2020) demonstrated that PU and PEoU are significant predictors of the intention to adopt an ERP system in retail and distribution companies. Based on these findings, hypotheses H2 and H3 are formulated as follows:

H2. Perceived Usefulness of the ERP system positively impacts Attitudes to Use.

H3. Perceived Ease of Use of the ERP system positively impacts Attitude to Use.

External Factors (EF) were analyzed by Sternad Zabukovšek et al. (2019) using several dimensions, including System Complexity, System Performance, User Manuals, Social Influence, and Business Process Fit. System Complexity refers to the dynamics of processing large transaction volumes within the ERP system. System

Performance in terms of operational characteristics is critical to a successful implementation. Comprehensive User Manuals provided by the ERP vendor play an important role in this process. Social Influence represents the perspective of the key individuals guiding the ERP acceptance process. Finally, Business Process Fit assesses the extent to which the technology aligns with the organization's current processes. Taken together, these factors form a valid argument for the successful use and implementation of ERP systems. The EF construct can be viewed as a higher-order construct comprising five dimensions that describe the theoretical relationships and positive indicators that support the construct. Therefore, the following hypothesis H4 is proposed in this study:

H4. External Factors significantly impact the Attitude to use the ERP system.

The Attitude to Use (AT) guides a person's plans to perform a characteristic behavior or action based on subjective beliefs (Calisir et al., 2009). AT is a strong predictor of actual behavior when using an ERP system in real-life situations (Gbongli et al., 2019; Wang et al., 2022). Numerous studies (Uddin et al., 2020; Akrong et al., 2022) indicate that attitude towards use has a direct influence on actual ERP use. Actual usage, the dependent construct, can be measured by the number of hours users spend using the ERP or familiarizing themselves with the advanced ERP functions (Spathis & Constantinides, 2003; Botta-Genoulaz & Millet, 2005). The actual use of the ERP system has a greater effect on business performance than the implementation of simpler technologies. Realizing the ERP's potential is the most important way to achieve the benefits of this system (Maas et al., 2014). Therefore, based on the above, hypothesis H5 is proposed as follows:

H5. Attitude to Use positively impacts the Actual Usage of the ERP system.

Experienced ERP users are likely to have different attitudes and beliefs towards ERP than those who are new to it. The literature shows that employees typically take 3-5 years to fully engage, produce, and focus on acquiring the knowledge needed to complete work tasks as efficiently as possible (Deranek et al., 2019). Therefore, User Experience (UE) is essential for ERP. In view of this, the following hypothesis H6 is put forward:

H6. User experience differentiates how Attitude to Use affects ERP system usage.

Based on the developed hypotheses, the proposed research model is shown in Figure 2.

3. RESEARCH METHODOLOGY

This section presents the research methodology used to analyze the factors influencing ERP usage. The sampling procedure, data collection and applied methods for data evaluation are described. The software packages IBM SPSS Statistics v.24.0, SmartPLS v.4 (Ringle et al., 2024), and the fs/QCA 3.0 software (Ragin & Davey, 2016) were used to perform the methodology.

3.1. Sampling and data collection

The questionnaire used in this study (see

Appendix) was adapted from the study by Sternad Zabukovšek et al. (2019). The second-order factor (External Factors) includes five predictor factors (Business Process Fit, System Complexity, Social Influence, System Performance, and User Manuals), which are based on eighteen questionnaire items. The first-order factors measured include Work Compatibility (three items), Perceived Ease of Use (two items), Perceived Usefulness (two items), Attitude to Use (two items), and Actual Usage (four items). All variables were assessed using a five-point Likert scale, ranging from 1 ("completely false") to 5 ("completely true"). Data was collected via an online questionnaire distributed via LinkedIn in 2024 to users of ERP system companies in the Western Balkans. Respondents were informed that their responses would be used for the preparation of a scientific paper. LinkedIn was selected as the main distribution channel as it is a professional networking platform with a wide reach among business practitioners and ERP users in various industries, ensuring effective access to the target audience. This platform offered a cost-effective and quick method of data collection that aligned with the study's focus on technologically savvy users working in modern digital business environments. To further expand the sample, snowballing was used as a non-probabilistic approach. The first respondents were asked to share the questionnaire with colleagues and employees in their companies who actively use ERP systems. This not only increased the response rate, but also helped to gain insights from ERP users beyond LinkedIn, increasing the diversity and representativeness of the data collected.

According to Hair et al. (2021), the minimum sample size can be determined based on the significance level (5%) and the minimum effect size in the PLS path model (p_{min}):

$$min\ sample = \left(\frac{2.486}{|p_{min}|} \right)^2 \quad (1)$$

Using equation (Eq.1), the minimum magnitude size in the PLS path model (p_{min}=0.20), the minimum sample size (*min*

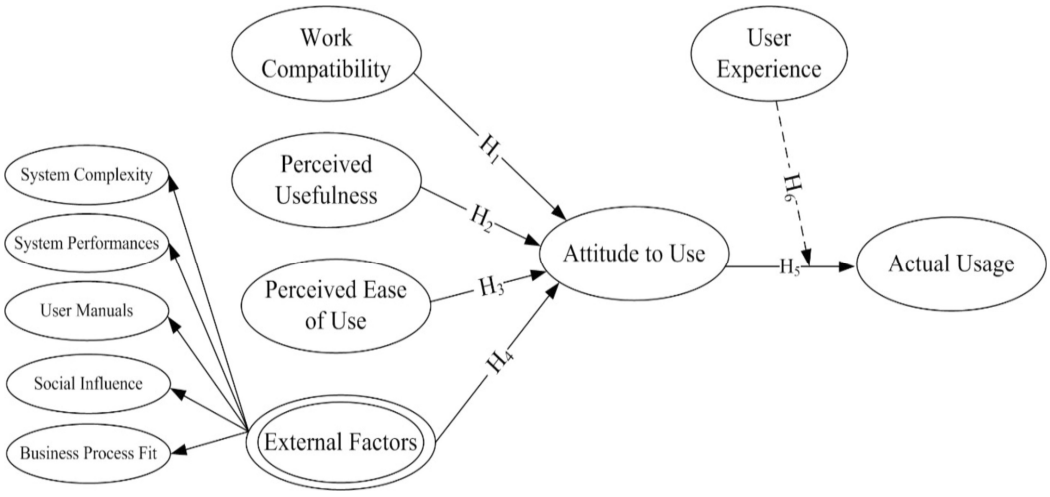

Figure 2. Research model

sample) should therefore be approximately 155. Once data collection was completed, a thorough review was conducted to ensure data quality by excluding incomplete responses and removing inconsistent answers. This resulted in a final sample of 180 valid questionnaires. As this study included more respondents than the required minimum sample, this sample size is considered sufficient for statistical analysis.

3.2. Methods

Moderation analysis is an approach used when the effect of an exogenous construct on an endogenous construct depends on another moderator variable (Hair Jr et al., 2014). This type of analysis has been applied in earlier ERP studies. For example, Uddin et al. (2020) used company size and user education as moderator variables to examine their influence on the relationship between the intention to use ERP and the actual use of ERP. Kalema (2013) investigated how age and education level affect the intention to use ERP effectively. Eid and Abbas (2017) also explored how users' level of experience with ERP acts as a moderating factor on the relationship between users' adaptation to ERP and their perceived usefulness of ERP. However, it is important to emphasize that success in using ERP systems depends not only on the technological potential of ERP, but also on the user experience of individuals interacting with the system (Bawa, 2024). To explore the presence of a moderating effect due to group differences, Multi-Group Analysis (MGA) was used in this study as part of the PLS-SEM methodology. This approach is used to test and identify significant differences between groups (Hair et al., 2021). A deeper understanding of group differences helps to make more accurate assessments and enables the implementation of tailored strategies for specific groups based on the results (Ruso et al., 2024).

In addition to the PLS-SEM approach, the fsQCA method was used in this study to gain a deeper understanding of the complex patterns of ERP usage. While PLS-SEM focuses on examining individual, linear relationships between variables, fsQCA analyzes how different combinations of factors can jointly contribute to high outcomes, providing a complementary perspective in data analysis (Arsić, 2025). The main objective of this analysis is to output solutions or combinations that suggest a particular generation of the exogenous construct (Pappas et al., 2020).

4. RESULTS

4.1. Demographic data

In the analyzed sample of 180 respondents, 56.1% were male and 43.9% were female. In addition, almost half of the respondents (48.9%) were between 30 and 39 years old. Most respondents had a BSc (44.4%) or MSc degree (41.7%), while only a small proportion had a PhD (1.7%). Most of the respondents work in large organizations with more than 250 employees (72.8%). In terms of industry type, 61.7% of respondents came from manufacturing industries such as automotive, pharmaceuticals, wood processing, mining and metallurgy, energy and food and beverage. Conversely, 38.3% of respondents belonged to the service sector, including software distribution, banking, retail, aviation and telecommunications. To address the issue of unequal sample sizes between

the predefined groups, the study also aims to obtain similar sample sizes for each group, especially for the manufacturing and service sectors.

4.2. Common method bias test

To ensure that the effect of common method bias is excluded, the Harman test for one factor was performed. This test tends to cluster all variables into a single factor. If this one factor explains more than 50% of the variance, this indicates a possible bias in the research sample (Polas, 2025). The results show that the variance of the first factor for this sample is 36.14%, which is less than 50%. This indicates that there is no effect of common method bias.

4.3. Symmetrical analysis

In this study, variance-based structural equation modeling, commonly known as PLS-SEM, was used to perform symmetric modeling. The measurement model and the structural model were analyzed.

4.3.1. Measurement model

Several tests were performed to assess the measurement model. One of the most commonly used reliability indicators is Cronbach's alpha (Cα) (Bonett & Wright, 2015). This indicator evaluates the reliability of the internal consistency of the questionnaire items. As shown in Table 1, the results of construct reliability and validity indicate that all items meet the required threshold values.

When evaluating measurement model, it is essential to assess discriminant validity. Various measures are used for this purpose. The Fornell-Larcker criterion was used. The results in Table 2 show that the square root of the Average Variance Extracted (AVE) for each construct shown on the diagonal is higher than its correlations with all other constructs, shown below the diagonal (Henseler et al., 2015). There is one exception between External Factors and Work Compatibility, but considering that the remaining values meet the established threshold, this does not indicate any discrimination issues. The Heterotrait-Monotrait (HTMT) matrix is used as a criterion that is compared to a predefined threshold, which is often set at 0.90 (Hair et al., 2019). Therefore, if the HTMT value exceeds this threshold, it indicates that there is no problem with discriminant validity.

4.3.2. Structural model

Figure 3 and Table 3 illustrate the structural model and the results of the hypothesis test, using the bootstrapping method with 5,000 iterations. The path coefficients indicate both the strength and

Table 1. Construct reliability and validity

	Cronbach's alpha (Cα)[a]	Composite reliability (rho_a)[b]	Average variance extracted (AVE)[c]
Actual Usage	0.772	0.829	0.594
Attitude to Use	0.825	0.854	0.849
External Factors	0.767	0.788	0.517
Perceived Ease of Use	0.852	0.869	0.871
Perceived Usefulness	0.828	0.829	0.853
Work Compatibility	0.900	0.902	0.834

Notes: [a]Cα≥0.70; [b]rhoa ≥0.70; [c]AVE≥0.50

direction of the relationships between the constructs, while the p-values reflect their statistical significance. The results support five of the six proposed hypotheses as their path coefficients are significant. For example, WC was found to have positive and significant effects on AT (H1: β=0.301, p=0.002). PU also shows positive and statistically significant effects on AT (H2: β=0.259, p=0.011). Conversely, PEoU has a

Table 2. Discriminant validity

	(1)	(2)	(3)	(4)	(5)	(6)
Fornell-Larcker criterion						
Actual Usage (1)	**0.771**					
Attitude to Use (2)	0.432	**0.922**				
External Factors (3)	0.494	0.702	**0.719**			
Perceived Ease of Use (4)	0.249	0.411	0.637	**0.933**		
Perceived Usefulness (5)	0.492	0.699	0.707	0.450	**0.924**	
Work Compatibility (6)	0.615	0.716	0.709	0.451	0.759	**0.913**
HTMT matrix						
Actual Usage (1)	-					
Attitude to Use (2)	0.505					
External Factors (3)	0.602	0.868				
Perceived Ease of Use (4)	0.289	0.486	0.805			
Perceived Usefulness (5)	0.602	0.839	0.868	0.535		
Work Compatibility (6)	0.722	0.818	0.856	0.514	0.877	-

Table 3. Results of hypotheses testing

	Construct	Path coefficient (β)	t-statistics	p-value (p)	VIF	f^2	Remark
H_1	WC → AT	0.301	3.155	0.002^{**}	2.861	0.081	Accepted
H_2	PU → AT	0.259	2.554	0.011^{***}	2.678	0.064	Accepted
H_3	PEoU → AT	- 0.054	0.742	$0.458^{n.s}$	1.685	0.004	Rejected
H_4	EF → AT	0.333	2.932	0.003^{**}	3.013	0.091	Accepted
H_5	AT → AU	0.413	5.198	0.000^{*}	1.006	0.228	Accepted
H_6	UE x AT → AU	0.177	2.250	0.024^{***}	1.000	0.037	Accepted

Notes: *significant at level ≤ 0.001, **significant at level ≤ 0.01, ***significant at level ≤ 0.05, $^{n.s}$non-significance

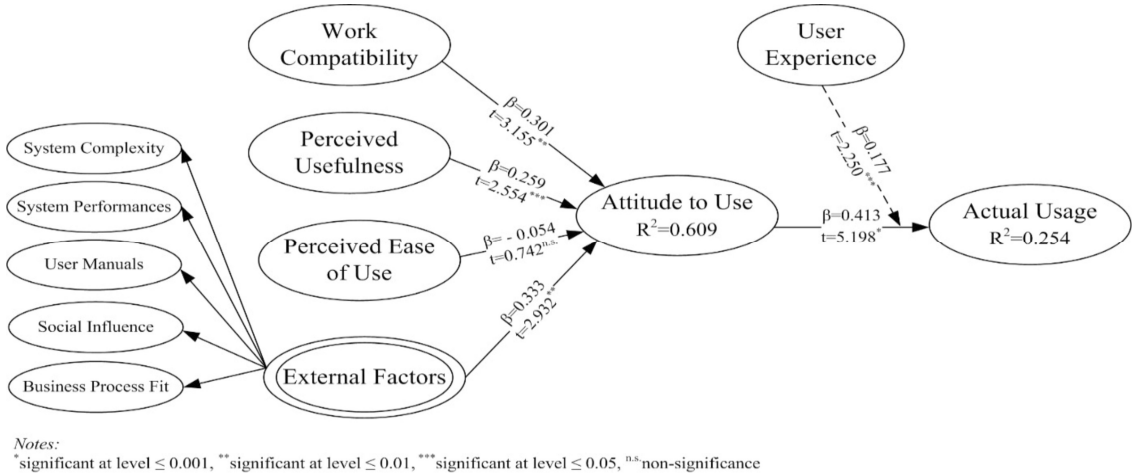

Figure 3. Structural model

negative effect on AT, but without statistical significance. Therefore, hypothesis H3 is rejected. Regarding EF and AT, this hypothesis (H4: β=0.333, p=0.003) was found to be significant and accepted, which is consistent with the relationship between AT and AU (H5: β=0.413, p=0.000). In addition, the moderating effect of User Experience was found to be statistically significant (H6: β=0.177, p=0.024). This result confirms that User Experience moderates the previously assumed influence of AT on the AU of the ERP system. All values of the Variance Inflation Factor (VIF), a measure of multicollinearity, are within the threshold of 5 recommended by Hair et al. (2022). Furthermore, f^2 represents the effect size and emphasizes the contribution of a predictor construct to the explained variance of the dependent endogenous construct. According to Table 3, all values are above 0.02 (as recommended by Cohen, 1988), with the exception of the rejected hypothesis PeOU→ AT (f^2=0.004). In addition, the Q^2 values of the endogenous constructs AT (Q^2=0.574) and AU (Q^2=0.311) demonstrate the predictive power of the model and indicate its predictive relevance (Hair et al., 2021).

The previous estimates of the moderation effect are shown in Figure 4. This suggests that ERP users with more experience have a stronger influence on their attitude towards using ERP, which in turn has a positive effect on actual usage compared to those with less experience.

The PLS-MGA analysis was used to explore the potential differences in the model between ERP users in the manufacturing and service industries. Table 4 shows the results

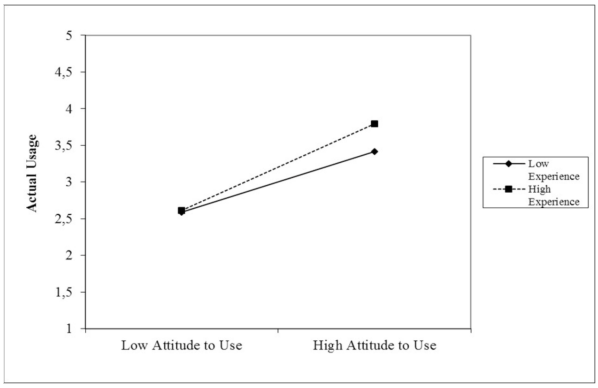

Figure 4. Moderation effect of User Experience

Table 4. Bootstrapping MGA results

Relationship	Manufacturing		Service		Manufacturing vs Service		
	path coefficient (β_m)	p-value (p_m)	path coefficient (βs)	p-value (p_s)	$\lvert \beta_m - \beta_s \rvert$	p-value	Significance
WC → AT	0.147	0.266	0.428	0.013	0.281	0.197	n.s.
PU → AT	0.345	0.014	0.228	0.194	0.117	0.594	n.s.
PEoU → AT	-0.063	0.409	0.043	0.754	0.106	0.501	n.s.
EF → AT	0.439	0.001	0.116	0.559	0.323	0.171	n.s.
AT → AU	0.363	0.001	0.545	0.000	0.182	0.226	n.s.
UE x AT → AU	0.159	0.113	0.212	0.116	0.053	0.728	n.s.

Note: [n.s]non-significance

of the bootstrapping MGA.

The results show that the difference between the subsamples, namely respondents from the manufacturing and service sectors, is not statistically significant. As the results did not reveal any differences between these sectors, the fsQCA analysis was performed for the entire sample.

4.4. Asymmetrical analysis

In order to gain insights into a problem that explores solutions related to the combination of the investigated factors leading to high and low/medium actual utilization of the ERP system, fsQCA was conducted. Table 5 shows the percentiles used for the first step of fsQCA, namely direct data calibration.

The results of the necessary conditions analysis, presented in Table 6, indicate that Attitude to Use (0.945) meets the criteria for a necessary condition to achieve ERP use, with a consistency value of over 0.90 (Ragin, 2006).

Perceived Usefulness (0.800) and Work Compatibility (0.850) are also conditions with consistency values ranging between 0.80 and 0.90, which is considered "almost always necessary" according to Pappas and Woodside (2021).

The results for the intermediate solutions are shown in Table 7. Appropriate recipes for high and low levels of the target construct should exceed the thresholds of 0.80 for consistency and 0.20 for coverage (Acquah et al., 2023). Coverage indicates how well a solution can explain all variations in the outcome, similar to R2 in PLS-SEM analysis.

Four solutions (S1-S4) for high actual use have a consistency of 0.792 and coverage of 0.762. Conversely, five solutions (S5-S9) for low/medium actual use of the ERP system have a consistency of 0.720 and coverage of 0.805.

Solution 1 shows that a combination of existing work compatibility, lack of perceived ease of use, lack of external factors and existing attitude towards use leads to

Table 5. Percentiles for data calibration

Variable → Thresholds ↓	External Factors	Perceived Ease of Use	Perceived Usefulness	Work Compatibility	Attitude to Use	Actual Usage
5th percentile	3.11	2.00	3.00	2.68	3.00	2.25
50th percentile	3.89	4.00	4.50	4.33	4.00	4.00
95th percentile	4.39	5.00	5.00	5.00	5.00	5.00

Table 6. Analysis of necessary conditions

Conditions	AU		~AU	
	Consistency	Coverage	Consistency	Coverage
fEF	0.577	0.533	0.743	0.742
~fEF	0.721	0.722	0.532	0.576
fPEOU	0.634	0.576	0.728	0.708
~fPEOU	0.679	0.694	0.567	0.626
fPU	0.553	0.469	0.800	0.734
~fPU	0.686	0.761	0.421	0.504
fWC	0.553	0.460	0.850	0.763
~fWC	0.716	0.816	0.398	0.490
AT	0.789	0.489	0.945	0.633
~AT	0.410	0.873	0.238	0.548

high actual use. Solution 2 emphasizes that high actual use of the ERP system is achieved when perceived usefulness is present, perceived ease of use is absent, external factors are present and attitude towards use is present. Solution 3 states that perceived usefulness is present, perceived ease of use is present, external factors are absent, and attitude to use is present, increase actual usage. Solution 4 proposes that a combination of work compatibility presence, perceived ease of use presence, presence of external factors, and attitude to use presence leads to a high actual usage of the ERP system.

For low/medium ERP Actual Usage, solution 5 indicates that, in the absence of work compatibility, perceived usefulness, perceived ease of use, and absent attitude to use, low scores of ERP system actual usage are driven. Solution 6 suggests that, absence lack of work compatibility, external factors and attitude towards use, will result in low actual use of the ERP system. Solution 7 shows that a combination of absent perceived usefulness, and both existing perceived usefulness and external factors results in low/medium AU. To achieve low/medium actual use of the ERP system, solution 8 suggests that all factors absence, namely, work compatibility, perceived usefulness, perceived usefulness, and external factors. Finally, to achieve a low/medium actual use of the ERP system, solution 9 implies a combination of the absence of the following factors, namely work compatibility, perceived usefulness, perceived ease of use and attitude towards use the ERP system.

5. DISCUSSION

The PLS-SEM results revealed significant predictors of actual ERP usage, while the fsQCA analysis confirmed a combination of factors that promote ERP usage.

According to the results, WC has a positive impact on AT in relation to ERP, and this relationship is statistically significant. This result is also supported by previous

Table 7. FsQCA findings

Configuration	Solutions (S) for high Actual Usage				Solutions (S) for low/medium Actual Usage				
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**
Work Compatibility	●			●	⊗	⊗			⊗
Perceived Usefulness		●	●				⊗	⊗	⊗
Perceived Ease of Use	⊗	⊗	•	•	⊗		•	⊗	⊗
External Factors	⊗	•	⊗	•		⊗	•	⊗	⊗
Attitude to Use	•	•	•	•	⊗	⊗		⊗	
Consistency	0.869	0.902	0.849	0.847	0.846	0.856	0.855	0.866	0.883
Raw Coverage	0.339	0.379	0.361	0.582	0.571	0.592	0.332	0.492	0.463
Unique Coverage	0.034	0.044	0.024	0.195	0.029	0.062	0.042	0.015	0.001
Overall Solution Coverage		0.762					0.720		
Overall Solution Consistency		0.792					0.805		

Notes: ● = causal condition present; ⊗ = causal condition absent; blank space = do not care. Large circle = core condition; small circle = peripheral condition.

studies (Sun et al., 2009; Cheng, 2018; Sternad Zabukovšek et al., 2019), which indicate that the better ERP systems are matched to users' specific task characteristics, the greater their influence on attitude. However, this result is at odds with the study by Lutfi et al. (2022), which focuses more on small and medium-sized enterprises. It should be noted that in this sample, over 70% of respondents work in large organizations. Considering that large enterprises have complex and less flexible processes and procedures (Buonanno et al., 2005), the compatibility between the work requirements and the ERP functions is crucial for users from such organizations. If the newly implemented ERP system is compatible with the existing technical systems and business practices, it leads to a positive attitude of users towards ERP acceptance (Rajan & Baral, 2015).

As expected, PU also has a positive, statistically significant effect on AT. This aligns with previous studies (Lee & Kim, 2016; Yasar & Ozer, 2016; Jo & Bang, 2023) and indicates that the ERP system is seen as a useful technology when it is relevant for handling all activities.

To the extent that users believe the use of the specific ERP system will not be difficult, PEoU was found to have a negative but not statistically significant effect on AT. This is in contrast to previous studies (Lee et al., 2010; Hancerliogullari Koksalmis & Damar, 2022). The rejection of this hypothesis could be influenced by the age and educational background of the respondents (Baker et al., 2010; Kiburu et al., 2023), although it should be emphasized that most of the participants in this study are under 39 years old and have a bachelor's or master's degree, which suggests that they are familiar with the complexity of ERP. The national culture of the Western Balkans (WBC) region, where the study was conducted, is characterized by a strong resistance to change, which negatively affects the adoption of ERP systems. These observations are consistent with the findings of Alhirz and Sajeev (2015), who indicated that greater resistance to change is associated with lower adoption of ERP systems.

This study showed a positive and statistically significant relationship between EF and AT. The findings of Sternad Zabukovšek et al. (2019) suggest that EF is a significant determinant of user attitudes, with a favorable organizational and technological environment and individual readiness contributing significantly to positive acceptance and use of ERP systems.

This study demonstrated a statistically significant relationship between AT and AU of the ERP system. Numerous studies confirm that users who perceive ERP systems as useful, reliable and user-friendly are more likely to report higher levels of commitment to these systems (Shih & Huang, 2009). In the context of ERP systems, these findings emphasize the importance of fostering positive user perceptions through training, education, and the early involvement of end-users in the system implementation process, which can improve their actual usage.

UE has a positive moderating effect on the relationship between AT and AU, which indicates that users with more experience in ERP use have more positive attitudes towards ERP compared to less experienced users, which is in line with findings of the Deranek et al. (2019). Users who have been using ERP for a longer period of time are more willing to explore additional functions in ERP software than users with less experience (Bawa, 2024). For new users,

their positive attitude may not lead to the same level of utilization, as they have not yet developed the skills or confidence to fully use the system's features. However, this finding contrasts with a study by Eid and Abbas (2017), which found that the level of user experience with ERP did not have significant moderating effect on the relationship between user adaptation and user benefits of ERP.

In addition to the PLS-SEM analysis, an MGA was also carried out to explore the differences in ERP adoption between the manufacturing and service industries. The results indicate that there are no significant differences in the established model relationships between these two types of industries. This is consistent with the study by Ruivo et al. (2017), who find that ERP usage is not relevant to understanding the value of ERP in either the manufacturing or service industries. In contrast, Abu Afifa et al. (2023) report that ERP adoption is more widespread in the manufacturing sector than in the service and financial sectors. The lack of significant differences is due to the increasing standardization and modularity of ERP systems. As ERP modules become more flexible and configurable both manufacturing and service companies can tailor functionalities such as inventory, finance and operations to their respective needs, leveling the playing field across the sectors. According to Kim et al. (2020), the percentage of ERP users in the manufacturing sector is 94 and 78.5% in the service sector, indicating a high normalization of ERP use across industries. Global industry reports also show that while manufacturing remains the largest vertical for ERP implementations, service industries, including e-commerce, healthcare and financial services, are rapidly increasing their adoption of ERP systems, often exceeding or even matching the rates of manufacturing (Mann, 2023; Gitnux, 2024).

The results of the fsQCA show that a certain combination of perceived usefulness, external factors and attitude towards use, together with the lack of perceived ease of use, leads to high levels of actual ERP system usage. In addition, the combination of the presence of work compatibility and attitude towards use together with the absence of perceived ease of use and external factors, also contributes to high ERP usage.

6. CONCLUSION

In an era characterized by rapid technological progress and growing competitive pressure, the adoption of integrated information systems such as ERP has become a crucial component of digital transformation in many industries. This study examined the current state of ERP usage in the Western Balkans, particularly in the manufacturing and service sectors that are vital to the region's economic development. Using a combination of advanced analytical methods, the study provides a nuanced understanding of the factors influencing ERP adoption and utilization. The results derived from the PLS-SEM analysis show that work compatibility, perceived usefulness, external factors and attitude towards use are significant predictors that influence the actual use of ERP systems, which was confirmed by the fsQCA results.

This study provides important theoretical and practical insights into the use of ERP systems. From an academic perspective, it enriches the existing literature by integrating several analytical approaches, PLS-SEM,

MGA, and fsQCA, to investigate the complexity of ERP use. In particular, this study is among the first to examine sectoral differences in ERP adoption and usage between the manufacturing and service sectors in the WBC region. The results show that there are no statistically significant differences in users' beliefs, attitudes, or behavioral intentions between these sectors, indicating a common pattern of ERP adoption regardless of industry type.

In addition to its theoretical contributions, the study also has practical implications for business managers, ERP vendors and policymakers. The findings provide valuable insights into the key success factors for ERP implementation and offer strategic guidance for driving further improvements in WBC companies on their digital transformation journey. In addition, the study emphasizes the importance of user experience. The more time users spend with the ERP system, the better their knowledge and frequency of use becomes, leading to better work performance over time. Finally, for ERP solution providers, the results suggest that the two analyzed industries do not differ in terms of the adoption of ERP systems. This indicates that other influential variables need to be examined in the development and implementation of ERP solutions, such as organizational readiness, change management capabilities, and leadership support. Future research should build on these results to further uncover the complex dynamics of ERP adoption in developing regions.

While this study offers valuable insights into ERP use in the specific context of the Western Balkans, the geographical scope may limit the applicability of the results for other regions with different economic, cultural, or institutional characteristics. However, considering the research gap and the relative lack of empirical studies in this area, the study makes an important and timely contribution to the understanding of ERP use in developing countries. Future research could build on this work by conducting comparative studies across different regions to examine contextual differences and improve applicability on a broader scale.

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ФАКТОРИ КОЈИ УТИЧУ НА КОРИШЋЕЊЕ ERP СИСТЕМА У ПРОИЗВОДНИМ И УСЛУЖНИМ ДЕЛАТНОСТИМА: КОМПАРАТИВНА СТУДИЈА ПРИМЕНОМ PLS-SEM И FSQCA

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Извод

Системи за планирање ресурса предузећа (енг. *Enterprise Resource Planning - ERP*) представљају важну технолошку инфраструктуру за побољшање оперативне ефикасности и стратешког доношења одлука у различитим индустријама. Ова студија испитује кључне детерминанте које утичу на усвајање *ERP* система, са посебним фокусом на организације које послују у производном и услужном сектору у региону Западног Балкана. Да би се емпиријски проценио предложени концептуални оквир, коришћено је моделирање структурних једначина парцијалних најмањих квадрата (енг. *Partial Least Squares Structural Equation Modeling - PLS-SEM*) и квалитативна компаративна анализа фази скупова (енг. *Fuzzy Set Qualitative Comparative Analysis - fsQCA*). На овај начин, обухваћене су и линеарне везе и конфигурациони путеви који леже у основи понашања при имплементацији *ERP*-а. Резултати *PLS-SEM* анализе показују да су конструкти као што су компатибилност посла, перципирана корисност и спољни фактори статистички значајни предиктори ставова корисника према коришћењу *ERP* система. Поред тога, пронађена је значајна веза између става и стварне употребе *ERP* система, при чему корисничко искуство служи као модераторска променљива. Приметно је да вишегрупна анализа није открила значајне разлике у намерама, ставовима или преференцијама између корисника из производног и услужног сектора. Резултати студије *fsQCA* такође показују да су компатибилност са послом и перципирана корисност кључни тренутни услови неопходни за ефикасно усвајање *ERP*-а. Ова студија доприноси постојећој литератури интегришући вишеструке аналитичке приступе како би се истражила сложеност коришћења *ERP*-а. Поред тога, пружа практичне увиде менаџерима предузећа, добављачима *ERP*-а и креаторима политике.

Кључне речи: ERP систем, производни сектор, сектор услуга, PLS-SEM, fsQCA

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APPENDIX

Measurement scale items

Construct and scale items		Min	Max	Mean	Std. Deviation
Work Compatibility					
WC_1	Using ERP system is compatible with all aspects of my work.	1	5	4.15	0.912
WC_2	Using ERP system fits well with the way I like to work.	1	5	4.30	0.865
WC_3	Using ERP system fits into my work style.	1	5	4.29	0.887
Perceived Usefulness					
PU_1	Using ERP solution in my job enables me to accomplish tasks more quickly.	1	5	4.36	0.876
PU_2	Using ERP solution improves my job performance.	1	5	4.29	0.895
Perceived Ease of Use					
PEoU_1	My interaction with ERP solution is clear and understandable.	1	5	4.01	0.881
PEoU_2	I find ERP solution is easy to use.	1	5	3.81	1.009
System Complexity					
SC_1	Using the ERP system takes too much time for my normal duties.	1	5	2.11	1.138
SC_2	Using the ERP system is so complicated.	1	5	2.03	1.131
SC_3	Using the ERP system involves too much doing mechanical operations.	1	5	2.30	1.088
System Performance					
SP_1	It is fast to search data in the ERP system.	1	5	4.23	0.914
SP_2	The ERP system loads quickly.	1	5	4.22	0.929
SP_3	I was able to retrieve data quickly.	2	5	4.23	0.799
SP_4	It is fast to create a new record (vendor, customer etc.) in this system.	1	5	4.17	0.864
SP_5	I finish my tasks in ERP system quickly	1	5	4.04	0.977
User Manuals					
UM_1	The content and index of the user manuals are useful.	1	5	3.63	1.062
UM_2	The user manuals are current (up to date).	1	5	3.62	1.047
UM_3	The user manuals are complete.	1	5	3.61	1.059
Social Influence					
SI_1	My supervisor is very supportive of the use of the ERP system for my job.	1	5	4.67	0.709
SI_2	In general, the organization has supported the use of the ERP system.	1	5	4.76	0.601
SI_3	People who are important to me think that I should use the ERP system.	2	5	4.34	0.880
Business Process Fit					
BPF_1	The ERP solution fits well with the business needs of me	1	5	4.45	0.757
BPF_2	The ERP solution fits well with the business need of my department.	1	5	4.45	0.807
BPF_3	I believe that there are not important problems with the way the ERP system is managed.	1	5	3.84	1.047
BPF_4	The system maintenance and the way it is provided meet my need adequately.	2	5	4.46	0.696
Attitude to Use					
AT_1	Using the ERP system is a good idea.	1	5	4.59	0.782
AT_2	I like the idea of using the ERP system to perform my job.	1	5	4.53	0.794
Actual Usage					
AU_1	I use ERP intensively.	1	5	4.45	0.892
AU_2	I use most of the modules available in ERP on a monthly basis.	1	5	3.87	1.235
AU_3	I use more functions per month than other ERP users.	1	5	3.89	1.241
AU_4	I use new unknown features offered by ERP every month.	1	5	3.24	1.293