



**39. Međunarodni kongres
o procesnoj industriji**
Negotin, 3. i 4. jun 2026.

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PROCESING '26**



ZBORNİK RADOVA
39. Međunarodnog kongresa o procesnoj industriji
(Negotin, 3. i 4. jun 2026)

IZDAVAČ

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inženjera i tehničara Srbije (SMEITS)
– Društvo za procesnu tehniku –
Kneza Miloša 7a/II, 11000 Beograd
2026. god.*

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PREDGOVOR

Procesna industrija ulazi u period velikih promena, u kome se od kompanija očekuje da proizvode efikasnije, smanje emisije, uvode obnovljive izvore energije i koriste digitalne alate.

Pred Vama je zbornik radova 39. Međunarodnog kongresa o procesnoj industriji - Procesing '26, kongresa koji već tradicionalno predstavlja ključnu tačku preseka naučne misli, tehnološkog razvoja i inženjerske prakse u procesnoj industriji.

39. Međunarodni kongres o procesnoj industriji Procesing '26, u organizaciji Društva za procesnu tehniku, pri Savezu mašinskih i elektrotehničkih inženjera i tehničara Srbije (SMEITS), u saradnji sa Katedrom za procesnu tehniku Mašinskog fakulteta u Beogradu i pod generalnim pokroviteljstvom kompanije Elixir Prahovo - Elixir Group, održan je 3. i 4. juna 2026. u svečanoj sali La Moara u Negotinu, gde se uspešno organizuje drugu godinu zaredom. Kompanija Elixir Group je po treći put pokazala da je pouzdan partner u organizaciji Procesinga, ove i prethodne godine u Negotinu, a prvi put u Šapcu 2023. godine. Kompanija Elixir Group nije samo formalno bila pokrovitelj već je uzela učešće u kreiranju programa Procesinga i predložila teme, moderatore i učesnike panela. Pomoć u organizaciji Procesinga '26 dali su predstavnici drugih fakulteta i instituta iz Srbije, među kojima su predstavnici Tehnološko-metalurškog fakulteta Univerziteta u Beogradu, Fakulteta organizacionih nauka i predstavnici Institut za nuklearne nauke "Vinča".

Pored generalnog pokroviteljstva od strane Elixir Prahovo – Elixir Group, finansijsku podršku skupu obezbedile su sledeće institucije i kompanije:

- Ministarstvo nauke, tehnološkog razvoja i inovacija, Republika Srbija*
- Inženjerska komora Srbije,*
- Institut za nuklearne nauke „Vinča“,*
- Beo čista energija, Beograd,*
- Numikon, Zagreb,*
- Geotaur, Beograd,*
- Grundfos Srbija, Beograd,*
- Kazantrade Srbija, Beograd i*
- Wilo Beograd.*

Osnovni ciljevi Procesinga '26 su uspešno realizovani spajanjem nauke i industrije, kroz umrežavanje i stručno usavršavanje inženjera i istraživača u oblastima procesne tehnike, energetike, inženjerstva zaštite životne sredine i menadžmenta kvaliteta i standardizacije. Pored tradicionalne podrške razvoju novih inženjerskih rešenja, težište ovogodišnjeg skupa usmereno je ka održivosti, primeni obnovljivih izvora energije, smanjenju štetnih emisija i implementaciji principa cirkularne ekonomije. Uz jasnu viziju potpunog zatvaranja ciklusa od otpada do novog proizvoda, kongres trasira put ka ostvarivanju ciljeva održivog razvoja u procesnoj industriji. Ovakva razmena iskustava i definisanje pravaca daljih istraživanja predstavljaju direktan doprinos modernizaciji postojećih kapaciteta i zelenoj tranziciji domaće privrede.

Ovakav sveobuhvatan pristup stvara ključne preduslove za podizanje tehnološkog razvoja naše zemlje i uvođenje naprednih, ekološki odgovornih tehnologija. Da su ovi preduslovi već uveliko u fazi realizacije, svedoče upravo radovi sabrani u ovom Zborniku. Publikovana istraživanja jasno pokazuju da domaća naučna zajednica uspešno ide u korak sa globalnim trendovima, nudeći konkretna rešenja za transformaciju

tradicionalnih procesa i optimizaciju raspoloživih resursa. Ujedno, ovi tekstovi donose jasnu viziju o tome kako oblikovati novi inženjerski kadar, sposoban da iznese teret ove kompleksne zelene i tehnološke tranzicije.

Kongres Procesing '26 je organizovan prema pravilima definisanim za međunarodne skupove što određuje svrstavanje i kvantifikaciju radova autora. U Naučnom i Organizacionom odboru Procesinga '26 bili su uključeni predstavnici mašinskih, tehnoloških i drugih fakulteta iz Srbije (Beograda, Novog Sada, Niša, Leskovca, Kragujevca, Kraljeva i Zrenjanina), kao i iz zemalja regiona i sveta, u okviru kojih je oblast procesne tehnike zastupljena u nastavi i istraživanjima (Podgorica, Sarajevo, Tuzla, Skoplje, Zagreb, Temišvar, Maribor, Trondhajm, Madrid, Vankuver).

Pored naučnih i stručnih radova, program skupa su obogatili i paneli posvećena najaktuelnijim pitanjima procesne industrije, Industrija i veštačka inteligencija: od digitalne spremnosti do Industrije 5.0, zatim Industrija i klimatski zahtevi: smanjenje emisija gasova sa efektom staklene bašte, monitoring i regulatorni okvir, kao i tradicionalni panel posvećen opremi pod pritiskom, kao jednoj od najvažnijih i najzahtevnijih oblasti procesne industrije. Učesnici su kroz pažljivo odabrane teme dobili konkretna znanja i jasne preporuke za unapređenje rada. Na ovim dinamičnim platformama za otvoreni dijalog, razmenu iskustava i kreiranje smernica za dalji razvoj sektora, učestvovali su vodeći stručnjaci iz industrije, predstavnici akademske zajednice, nadležnih ministarstava i vodećih domaćih i međunarodnih kompanija.

Kao i na prethodnom Procesingu, ovogodišnji skup je obogatio i sajamski prostor, gde je u izložbenom delu bio organizovan sajam opreme koja se koristi u procesnoj industriji, i koji je okupio brojne izlagače i učesnike.

Kongres je završen stručnom posetom učesnika skupa Industrijskom kompleksu Eliksira u Prahovu, odnosno Ogranku Eco Energy - Postrojenju za energetske iskorišćenje otpada u Prahovu, gde su imali priliku da se upoznaju sa skorim početkom rada postrojenja, savremenim procesima upravljanja i energetskog iskorišćenja otpada, kao i o standardima zaštite životne sredine koji se u njemu primenjuju. Takođe, učesnici skupa su imali priliku da obiđu i muzej, jedinstven u Srbiji, jer predstavlja svedočanstvo o izgradnji i razvoju jedne hemijske industrije od 1960. do danas.

*U Beogradu,
jula 2026.*

Predgovor

Energija u procesnoj industriji

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kvalitet ERP sistema; ANOVA;
diskretna industrija;
procesna industrija

PROCENA KVALITETA ERP REŠENJA KROZ PERFORMANSE SISTEMA: DOKAZI ZASNOVANI NA ANOVA ANALIZI IZ DISKRETNE I PROCESNE INDUSTRIJE

Key words:

ERP system quality; ANOVA;
discrete industry; process industry

ASSESSING ERP SOLUTION QUALITY THROUGH SYSTEM PERFORMANCE: ANOVA-BASED EVIDENCE FROM DISCRETE AND PROCESS INDUSTRIES

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Kvalitet ERP sistema igra ključnu ulogu u poboljšanju organizacione efikasnosti integrisanjem poslovnih procesa omogućavanjem razmene informacija u realnom vremenu. Međutim, percepcija kvaliteta ERP sistema može da varira u različitim industrijskim kontekstima. Ova studija ispituje da li postoje statistički značajne razlike u percipiranim performansama ERP sistema između korisnika u diskretnoj i procesnoj industriji. Empirijski podaci su prikupljeni putem onlajn ankete među 100 korisnika ERP sistema zaposlenih u preduzećima koja posluju u Srbiji. Kvalitet ERP sistema meren je efikasnošću pretrage podataka, vremenom učitavanja sistema, preuzimanjem podataka, kreiranjem dokumenata i izvršavanjem zadataka. Metoda analize varijanse (ANOVA) primenjena je za testiranje razlika u percepciji korisnika između dva tipa industrija. Rezultati ukazuju na statistički značajne razlike u percepcijama vezanim za efikasnost pretrage podataka i brzinu učitavanja sistema, dok nisu pronađene značajne razlike za preuzimanje podataka, kreiranje dokumenata i izvršavanje zadataka. Studija doprinosi literaturi pružajući empirijske dokaze o razlikama u percepciji performansi ERP sistema zasnovanim na industriji. Sa praktične perspektive, rezultati ističu važnost prilagođavanja dizajna i konfiguracije ERP sistema specifičnim operativnim potrebama različitih industrijskih okruženja. Buduća istraživanja bi mogla proširiti analizu uključivanjem dodatnih dimenzija kvaliteta ERP-a i šireg uzorka.

Enterprise Resource Planning (ERP) system quality plays a critical role in improving organizational efficiency by integrating business processes and enabling real-time information exchange. However, perceptions of ERP system quality may vary across different industrial contexts. This study examines whether statistically significant differences exist in perceived ERP system performance between users in discrete and process industries. Empirical data were collected through an online survey of 100 ERP users employed in enterprises operating in Serbia. ERP system quality was measured by data search efficiency, system loading time, data downloading, document creation, and task execution. The analysis of variance (ANOVA) method was applied to test differences in user perceptions between the two industry types. The results indicate statistically significant differences in perceptions related to data search efficiency and system loading speed, while no significant differences were found for data downloading, document creation, and task execution. The study contributes to

the literature by providing empirical evidence on industry-based differences in ERP system performance perceptions. From a practical perspective, the results highlight the importance of adapting ERP system design and configuration to the specific operational needs of different industrial environments. Future research could extend the analysis by including additional ERP quality dimensions and a broader sample.

1. Introduction

The accuracy and timeliness of data and information are crucial for the quality of business processes, which contribute to overall corporate success. In this context, Enterprise Resource Planning (ERP) systems, as leading information system solutions covering most company operations, are essential for managing organisational activities (Balić et al., 2022). These systems support quality management through business process integration and digitalisation, easier quality tracking and error reduction, identification of process problems, analysis of deviations, and monitoring the effects of corrective or preventive measures.

ERP systems rely on standardised business rules, providing a central repository for entering all information and data regarding enterprise processes. Enterprises benefit from process standardisation, resource integration, and decision-making and problem-solving based on real-time data. These benefits are equally important for the enterprise and its stakeholders, as they lead to improved operations, enhanced product and service quality, increased efficiency, and reduced delivery times (Wei, 2008; Akrong et al., 2022).

ERP system application varies between different industry contexts, such as process and discrete industries, due to fundamental differences in production processes, product structures, and production planning methods (Lothary et al., 2024). As a result, ERP solutions are often developed with industry-specific modules to support the particular requirements of manufacturing systems.

However, the existing literature rarely empirically examines these differences at the level of ERP system users' perceptions. Therefore, a systematic analysis of differences in the perception of ERP system performance between users from the process and discrete industries is needed to better understand industry-specific characteristics in the evaluation of ERP solution quality. This study addresses the following research question: Are there statistically significant differences in perceived ERP system quality between discrete and process industries?

To answer this research question, the study uses System Performance (SP) as a metric of ERP system quality. SP refers to the operational efficiency of an ERP system, particularly its ability to respond rapidly to business activities and support the smooth execution of organisational processes. The ability of ERP systems to process transactions promptly and provide real-time information has also been associated with improvements in organisational performance indicators after implementation (Shbail et al., 2024).

After conducting empirical research in discrete and process industries operating in Serbia, this study applies a statistical approach based on the ANOVA test to assess potential differences in users' perceptions of ERP system quality. This approach can contribute to a more precise understanding of the factors influencing the successful use of ERP systems and provide a basis for adapting ERP implementations to the specific requirements of different industrial environments.

The paper is organised as follows. The Study Background reviews the literature and highlights the differences in ERP system usage between discrete and process industries. The Methodology section describes the data collection process and methods applied. Results and Discussion systematically

present the study results and clarify key findings. The Conclusion provides a brief summary, highlighting the study's contributions and limitations and proposing potential future research directions.

2. Study background

Implementing integrated solutions, such as an ERP system, can provide a company numerous benefits and improve the overall efficiency of departmental or enterprise operations. As a result, many studies examine the quality of ERP systems (Chang et al., 2011; Shen et al., 2016; Akrong et al., 2022; Balić et al., 2022; Abu Afifa et al., 2025), based on the belief that a well-implemented, high-quality ERP solution positively impacts the organisation.

Cebekhulu and Ozor (2022) examined the elements of quality management practices and ERP systems to assess the relationship between organisational culture and organisational performance. Their study suggests that ERP systems, measured through organisational impact, individual impact, information quality, and system quality, have a statistically significant and positive effect on organisational performance. In contrast, Balić et al. (2022) explored the relationship between ERP system quality and financial and non-financial organisational performance in a developing economy, covering manufacturing, wholesale and trade, information technology, and other industries. Their results indicate that system quality and its features do not have a statistically significant effect on the performance examined. The research suggests that ERP system quality, measured by necessary running, quick response, ease of use, and stability, is not a predictive driver of enterprise performance.

These conflicting findings may arise because different industrial contexts affect how ERP systems are perceived and used. Therefore, ERP system application may vary between process and discrete industries due to fundamental differences in production processes, product structures, and production planning methods.

In discrete industries, products consist of clearly defined components that can be disassembled and reassembled, so ERP systems in these organisations focus on managing product structures, planning material requirements, and coordinating assembly processes (Lothary et al., 2024). In contrast, the process industry relies on production through recipes or formulas, where raw materials are transformed by chemical or physical processes. This requires ERP functionalities such as recipe management, batch control, and traceability of raw materials and products (Itagi et al., 2023). Due to these specificities based on the nature of production processes, ERP solutions are often developed with industry-specific modules to support the distinct requirements of manufacturing systems.

Given that ERP systems in the process and discrete industries support different business processes and use different functional modules, it can be assumed that users in these two industrial contexts perceive ERP system performance differently, particularly regarding data processing speed, information availability, and task performance efficiency. This may lead to differences in ERP system quality perceptions.

In the literature, ERP quality is assessed through the dimensions of system quality, information quality, and service quality. ERP system quality refers to the capability of the computerised system to efficiently process information and the extent to which it meets required technical standards. ERP information quality relates to the relevance, accuracy, and usefulness of data provided by the system in meeting users' needs and expectations. ERP service quality represents the gap between users' expected level of technical support and the actual performance of the support services delivered by the information system team (Ouiddad et al., 2021).

To address the proposed research question, this paper adapts the SP construct items from Sternad Zabukovšek et al. (2019), including data search efficiency, system loading time, data downloading, document creation, and overall task execution. As previous research (Shen et al., 2016; Balić et al., 2022) also considered rapid response and effectiveness of ERP as dimensions of quality, this study's approach is appropriate for measuring ERP system quality. These indicators therefore provide a relevant basis for assessing perceived ERP system quality.

3. Methodology

To assess user perceptions of ERP system performance as a determinant of ERP system quality, an empirical survey was conducted in 2024. Data were collected from 100 users in enterprises operating in Serbia, targeting professionals who actively use ERP systems in their work. An online questionnaire was distributed via the LinkedIn network to ERP users. Participants were informed that their responses would be used exclusively for academic research purposes and that the data would be treated confidentially.

The questionnaire consisted of two parts. The first part included demographic questions, while the second comprised items related to ERP system acceptance and use (Sternad Zabukovšek et al., 2019). Five items specifically measured perceptions of ERP system performance. Respondents indicated their level of agreement using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

In this study, analysis of variance (ANOVA) was used to test whether users' perceptions of ERP system performance differ between enterprises operating in discrete and process industries. ANOVA is a statistical technique used to determine whether statistically significant differences exist between the mean values of two or more groups (Stoker et al., 2020). All statistical analyses were conducted using IBM SPSS Statistics, version 2025.

4. Results and discussion

Of the 100 ERP users surveyed, over 80% work in large companies with more than 250 employees. Approximately 70% of respondents have used ERP systems for more than three years, and 85% use ERP daily. Respondents reported using ERP systems across various company sectors, including marketing, projects, financial management, logistics, warehousing, quality assurance, and human resources. They also reported using ERP modules such as materials management, human resources, financial accounting, production planning, and quality management.

Descriptive statistics from the crosstabulation of users' demographic characteristics and industry type are presented in Table 1.

Table 1 shows that there were more males than females in both types of industry considered. Regarding respondents' age, most users in both process and discrete industries were aged 30–39. Most respondents held either a BSc or MSc degree. This study distinguishes the economic activity of the companies where respondents are employed, identifying the automobile industry as an example of a discrete industry, and pharmacy, mining and metallurgy, and food and beverage production as examples of process industries.

To test whether users' perceptions of ERP system performance differ between those in discrete and process industries, an ANOVA was conducted. Before conducting the ANOVA, the assumptions of normality, independence of observations, and homogeneity of variances were examined and met. The Cronbach alpha coefficient for the questionnaire items was 0.869, which is above the recommended value of 0.70 (Brown, 2002). The results of the ANOVA are presented in Table 2.

Table 1. Crosstabulation descriptive statistics

Classification	Subclassification	Type of industry		Total
		Process	Discrete	
Gender	Male	28	25	53
	Female	36	11	47
Age	20-29	17	8	25
	30-39	27	20	47
	40-49	16	8	24
	50-59	4	0	4
Level of education	High school	3	2	5
	School of Applied Science	3	1	4
	BSc	30	17	47
	MSc	27	16	43
	PhD	1	/	1
Economic activity	Automobile industry	/	36	36
	Pharmacy	20	/	20
	Mining and metallurgy	27	/	27
	Food and beverage production	17	/	17

Table 2. ANOVA test results regarding type of industry

Item	Discrete industry (Mean)	Process industry (Mean)	Between/Within Groups	Sum of Squares	df	Mean Square	F	p
SP1 - In ERP, data can be searched quickly	4.42	3.98	Between Groups	4.306	1	4.306	4.600	0.034*
			Within Groups	91.734	98	0.936		
SP2 - The ERP system loads rapidly	4.39	3.98	Between Groups	3.770	1	3.770	4.126	0.045*
			Within Groups	89.540	98	0.914		
SP3 - I can download data from ERP quickly	4.42	4.19	Between Groups	1.210	1	1.210	2.027	0.158 ^{n.s.}
			Within Groups	58.500	98	0.597		
SP4 - I can create a new document in ERP quickly	4.36	4.08	Between Groups	1.845	1	1.845	2.414	0.124 ^{n.s.}
			Within Groups	74.915	98	0.764		
SP5 - I complete tasks effectively in ERP	4.17	4.14	Between Groups	0.016	1	0.016	0.019	0.892 ^{n.s.}
			Within Groups	82.734	98	0.844		

Notes: *statistically significant at 0.05 level; ^{n.s.} not significant

ANOVA test results confirmed two statistically significant differences in users' perceptions of ERP system performance, while the remaining three statements were not statistically significant.

Significant differences were observed for SP1 ($F = 4.600$, $p = 0.034$) and SP2 ($F = 4.126$, $p = 0.045$). These results indicate that users from discrete and process industries perceive certain aspects of ERP system speed differently, particularly those related to data search efficiency (SP1) and system loading time (SP2). This suggests that differences in perceptions of ERP system performance between

discrete and process industries may be influenced by distinct operational characteristics and industry data processing requirements.

Discrete industries typically involve a large number of individual components, complex bills of materials, and frequent transactional operations related to production orders, inventory tracking, and assembly processes (Lothary et al., 2024). Consequently, ERP users in such environments often rely heavily on rapid data retrieval and system responsiveness to support daily tasks. In contrast, process industries usually operate with more continuous production flows and relatively standardised process structures, which may reduce the frequency of certain types of data searches and system queries (Itagi et al., 2023).

These findings are consistent with previous studies suggesting that perceptions of ERP system performance are often influenced by the complexity of operational processes and the intensity of system interaction within specific industrial environments (Madapusi & D'Souza, 2012).

No statistically significant differences were found for SP3 ($F = 2.027$, $p = 0.158$), SP4 ($F = 2.414$, $p = 0.124$), and SP5 ($F = 0.019$, $p = 0.892$). These findings suggest that users across both industries report similar experiences regarding data downloading (SP3), document creation (SP4), and overall task execution (SP5) within ERP systems. These functions are typically embedded within standardised ERP workflows and may therefore be perceived similarly across different industrial contexts.

5. Conclusion

This study aimed to examine whether differences exist in users' perceptions of ERP system performance as an indicator of ERP system quality between discrete and process industries. Using empirical data collected from 100 ERP users employed in Serbian enterprises, the study applied ANOVA to identify potential differences in perceived system performance across the two industrial contexts.

The results revealed statistically significant differences for two performance indicators, i.e. data search efficiency and system loading speed, suggesting that certain aspects of ERP responsiveness are perceived differently by users in discrete and process industries. In contrast, no significant differences were observed for data downloading, document creation, and overall task execution, indicating that these ERP functionalities are perceived similarly across the analysed industries.

These findings contribute to the literature on ERP system quality by highlighting the importance of considering industry-specific operational characteristics when evaluating ERP performance. From a practical perspective, the results suggest that ERP vendors and system implementers should pay particular attention to performance-related features such as system responsiveness and data retrieval efficiency when designing and configuring ERP solutions for different industrial environments.

Despite its contributions, this study has several limitations. The analysis was based on a relatively small sample and focused exclusively on enterprises operating in Serbia, which may affect the generalisability of the findings. In addition, the study examined only one dimension of ERP quality, namely system performance. Future research could extend the analysis by incorporating other dimensions of ERP quality, particularly information quality and service quality, to provide a more comprehensive evaluation of ERP system effectiveness across different industrial contexts.

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