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INTEGRATION OF THE METAVERSE INTO BUSINESS MODELS THROUGH MOBILE APPLICATIONS: AN ANALYSIS OF SERVICE SALES OPPORTUNITIES VIA PLATFORMS SUCH AS WHATSAPP, FACEBOOK, LINKEDIN, AND THREADS

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Abstract
This research analyzes the impact of integrating the metaverse into business models through mobile applications on service sales and user engagement. Using quantitative methods and online surveys, a sample of 300 respondents from various sectors enabled the collection of relevant data. Statistical analyses, including descriptive statistics, factor analysis, correlation, and regression analysis, revealed that technological integration, particularly the application of AR/VR technologies, significantly enhances the interactivity and immersiveness of the user experience. The results indicate a positive effect of metaverse presence in mobile applications on increased sales and user engagement, while simultaneously identifying challenges related to user trust and legal regulation. The findings provide practical insights into the optimization of business models and digital transformation, opening avenues for further research in the application of innovative digital solutions in business.
Keywords: metaverse, mobile applications, digital transformation, AR/VR technologies, user experience

INTEGRACIJA METAVERZUMA U POSLOVNE MODELE PUTEM MOBILNIH APLIKACIJA: ANALIZA MOGUĆNOSTI PRODAJE USLUGA KROZ PLATFORME POPUT WHATSAPP, FACEBOOK, LINKEDIN I THREADS

Apstrakt
Ovo istraživanje analizira uticaj integracije metaverzuma u poslovne modele putem mobilnih aplikacija na prodaju usluga i angažovanost korisnika. Korišćenjem kvantitativnih metoda i online anketiranja, uzorak od 300 ispitanika iz različitih sektora omogućio je prikupljanje relevantnih podataka. Statističke analize, uključujući deskriptivnu statistiku, faktorsku analizu, korelaciju i regresionu analizu, otkrile su da tehnološka integracija, naročito primena AR/VR tehnologija, značajno doprinosi interaktivnosti i imerzivnosti korisničkog iskustva. Rezultati pokazuju pozitivan uticaj prisustva metaverzuma u mobilnim aplikacijama na povećanje prodaje i angažovanosti, dok se istovremeno identifikuju izazovi vezani za poverenje korisnika i pravnu regulativu. Dobijeni nalazi pružaju praktične uvide u optimizaciju poslovnih modela i digitalnu transformaciju, čime se otvara prostor za dalja istraživanja u oblasti primene inovativnih digitalnih rešenja u poslovanju.
Ključne riječi: metaverzum, mobilne aplikacije, digitalna transformacija, AR/VR tehnologije, korisničko iskustvo

INTRODUCTION

The metaverse is defined as a digital environment that combines elements of augmented and virtual reality, allowing users an interactive experience through personalized avatars, digital transactions, and decentralized systems (Wang et al., 2023). Its essence is reflected in the ability to create fully immersive experiences, where the border between the physical and digital world is erased (Ahn et al., 2024). The development of the metaverse relies on key technological components such as blockchain, artificial intelligence and cloud computing (Dwivedi et al., 2022, Bailey and Leonardi, 2021). These technologies enable dynamic interactions, customized content, and real-time transactions, making the metaverse suitable for business applications, marketing, and sales of products and services (Chen et al., 2024). Metaverse is increasingly used in business sectors, as it enables personalized interaction with consumers, strengthening of brands and optimization of business processes. Key features include a sense of presence, digital economy, interactivity and flexibility in adapting business models (Boo and Suh, 2024, Zambrano-Vazquez, L., 2016).

Mobile applications such as WhatsApp, Facebook Messenger, LinkedIn and Threads have become key platforms for business communication and sales. The results of domestic research further confirm the importance of mobile applications for building relationships with consumers and developing modern business models. In the

research carried out on the Serbian market, it was shown that mobile applications, when they are well designed and allow users to feel control, competence and connection with the brand, significantly contribute to the development of consumer trust and loyalty in omnichannel retailing (Sokolov Mladenović, Đukić and Stanković, 2025). These findings indicate that the effects of mobile applications are not only exhausted in the transactional aspect, but also include the psychological dimensions of the user experience, which is especially important in the context of the metaverse, where interactivity and immersiveness further enhance the brand experience. Introducing the metaverse into these applications allows companies to use advanced methods of interaction, such as virtual meetings, 3D product displays and automated assistants based on artificial intelligence (Marshall and Bieck, 2024). The application of the metaverse in business opens up new opportunities in the retail, banking and customer support sectors (Sridharan and Kumar, 2024). Brands are increasingly using these platforms to create interactive shopping experiences, where users can visualize products in a digital environment before making a purchase decision (Jee et al., 2024). The interactive functions of the metaverse increase the likelihood of impulse purchases, as personalized offers and algorithms optimize marketing strategies and increase user engagement (Dang Quan et al., 2024). This aspect is particularly important for e-commerce, where shopping becomes fluid and user-friendly (Hollensen, Kotler and Opres et al., 2023).

The metaverse is developing as a central part of the digital economy, with the widespread use of cryptocurrencies, blockchains and decentralized financial systems (Ooi et al., 2023). The use of non-fungible tokens allows brands to create exclusive digital products and services, which opens up new sources of revenue (Hernández-Tamurejo et al., 2025). Decentralized finance is becoming a key part of the metaverse, enabling users to make safer and more transparent transactions (Dwivedi et al., 2022). Banks and financial institutions are increasingly exploring the potential of the metaverse for digital banking, offering interactive services through virtual branches (Ooi et al., 2023).

Although the metaverse offers numerous advantages, its widespread implementation faces several challenges. One of the key problems is the lack of education and understanding of this technology among business users (Louisot, 2024; Bourlakis, Papagiannidis and Li, 2009). Companies that want to implement the metaverse in their business must invest in infrastructure, employee training, and legal regulations related to digital markets (Duc et al., 2024). Another significant challenge relates to the privacy and security of user data. As the metaverse enables a deeper analysis of user behavior and preferences, the question of the ethical use of collected information arises (Wong, Law and Tan, 2024). The regulation related to data protection is still not fully defined, which may represent an obstacle in its mass implementation (Hudaefi, 2024; Deonisio, Burns and Gilbert, 2013). In addition to legal and technical barriers, the high cost of implementation can also be a limiting factor, especially for SMEs that do not have the resources to invest in digital technologies (Duc et al., 2024; Mystakidis, 2022).

The metaverse is increasingly shaping the global economy and redefining consumer behavior. Research shows that digital environments with a high degree of interactivity encourage greater user engagement and accelerate the decision-making process (Black, 2022; Tran et al., 2023). In the e-commerce sector, personalized shopping within the metaverse is becoming a dominant trend, with AI and algorithms tailoring offers to consumer needs (Jee et al., 2024; Oh and Ryu 2022). Brands are increasingly experimenting with virtual experiences to increase user loyalty and create exclusive digital products (Hernández-Tamurejo et al., 2025; Kaplan and Haenlein, 2009). The banking sector is also increasingly using the metaverse, allowing users to access financial services through digital avatars and interactive environments (Ooi et al., 2023; Gauttier et al., 2024). In domestic literature, the metaverse is predominantly considered through the prism of new business models and the need to adapt existing regulations and control mechanisms to the digital environment. For example, Mijailović and Medunjanin (2023) indicate the importance of digital forensic accounting for circular business models in the metaverse, emphasizing the need for transparency, traceability of transactions and new forms of control in virtual environments. Although the focus of their work is not on mobile applications and the sale of services, it shows that even in the regional context, the strategic importance of the metaverse for the future development of business is recognized. This raises new questions regarding the regulation and security of digital transactions, which is becoming a key issue for financial institutions (Hudaefi, 2024; Wu and Lu, 2023). Therefore, the metaverse can be seen not only as a technological innovation but also as a strategic tool for optimizing business models. Although there are numerous challenges, its impact on the digital economy and the way companies communicate with consumers continues to grow (Arghashi, 2024, Van der Heijden, 2004). It is obvious that in this sense, the future belongs to those who prepare for it today, so the potential of the metaverse is described not only as part of the digital space, but as the foundation for a new economic paradigm in which technology, business and consumer habits are intertwined. In the domestic and regional context, the process of digital transformation is still in the consolidation phase, with pronounced differences between individual sectors and companies. Analyzes of the innovation system and digital transformation in the Republic of Serbia show that, despite the growth of digital capacities, a significant part of companies still do not fully use the potential of modern digital technologies, which especially applies to advanced forms of business based on data and new digital ecosystems (Initiative "Digital Serbia", 2023). Similar findings appear in the analysis of the transformation of the media industry, where it is pointed out that new business models require a deeper integration of digital platforms, changes in organizational culture and continuous investment in innovation (Milin, 2024). In this sense, the integration of the metaverse into business models through mobile applications can be seen as a logical next step in the development of the digital economy in the region.

METHODOLOGY

The research was conducted through online survey research, which was distributed through digital channels such as LinkedIn, WhatsApp Business, Facebook groups, business forums and email distribution. The target population included professionals and entrepreneurs who use digital tools for business, with the sample including respondents from various sectors such as IT, finance, marketing, education and entrepreneurship. Data collection was conducted in the period from January 10, 2025 to March 5, 2025, through an online questionnaire distributed through social networks and direct calls to participants. The questionnaire contained four parts and a total of 30 questions, divided into demographic characteristics, familiarity with the metaverse, use of mobile applications in the context of the metaverse, and attitudes about the future use of the metaverse in business. The questions included multiple choice, open answers and a Likert scale from 1 to 5. For easier understanding of the results, representative questions that were directly analyzed within the research are shown below. Examples of key questions from the questionnaire: 1) "To what extent do you think that the metaverse can improve business models and sales of services through mobile applications?", 2) "How ready are you to use metaverse-integrated platforms for the sale of services?", 3) "What obstacles do you see in the implementation of the metaverse into business models through mobile applications?", 4) "To what extent do you consider the following factors to be obstacles to the implementation of the metaverse?" – lack of knowledge, user mistrust, implementation costs, technology availability, legal/regulatory issues, 5) "How would you rate the future impact of the metaverse on business models?", 6) "How suitable are the following applications to you for doing business within the metaverse?" – WhatsApp, Facebook, LinkedIn, Threads, 7) "Which aspects of the metaverse would motivate you the most to integrate it into your business?", 8) "Would you be interested in training on using the metaverse in business?". These questions are representative because they directly answer the main variables of your analysis (readiness, perception, obstacles). The total sample size was 300 respondents, which provided valid statistical data for analysis. The research took place in four phases: in the first phase, pilot testing was conducted with 20 respondents to check the clarity and comprehensibility of the questions. This was followed by the main phase of data collection, which lasted four weeks, during which responses were systematically collected and sorted. Upon completion of this phase, data processing and analysis, including descriptive statistics, correlation, and regression analysis, were conducted to identify key relationships between metaverse characteristics and business models based on mobile applications. The last phase included the interpretation of the results and the writing of a scientific paper, where conclusions were formulated and practical recommendations were proposed. The total time frame of the research was two and a half months, which enabled a comprehensive examination of the possibility of integrating the metaverse into

business models through mobile applications. For the purposes of this work, the following hypotheses were given:

The introduction of the metaverse into business models through mobile applications represents a significant step forward in the digital transformation of modern enterprises, enabling them to improve user engagement and increase sales of services in an innovative way. The key hypothesis of this research starts from the assumption that the integration of the metaverse into platforms like WhatsApp, Facebook, LinkedIn and Threads can improve the user experience through interactive and personalized approaches to digital marketing and sales. Supporting hypotheses examine specific aspects of this phenomenon in more detail, including the role of augmented and virtual reality (AR/VR) in creating an immersive experience, the importance of personalized digital interactions in the purchase decision-making process, and the impact of the metaverse on user loyalty and brand perception. It is especially important to investigate how the presence of companies in the metaverse can influence the conversion of users into customers, and to what extent consumers' trust in digital transactions determines their willingness to use such platforms to purchase services. Given the rapid development of digital ecosystems, the analyzes carried out in this research provide important insights into how business models can adapt to new technologies and how mobile applications can become key channels for selling services in the future metaverse. These hypotheses were tested using correlations, regression analysis, and factor analysis to assess the impact of the metaverse on digital business models and user behavior.

In this research, user experience and engagement in digital marketing and sales through the metaverse represent the dependent variable, while the independent variables include the integration of the metaverse into mobile applications (WhatsApp, Facebook, LinkedIn, Threads), the use of augmented and virtual reality in interaction with users, personalized digital interactions in the purchase decision-making process, the presence of companies in the metaverse and its impact on the conversion of users into customers, consumer trust in digital transactions and willingness to purchase services through the metaverse, and the development of digital ecosystems and the technological adaptability of business models, analyzing the extent to which these variables shape brand perception, customer loyalty, and the effectiveness of digital service sales channels. The research was conducted in accordance with the basic ethical principles of social research. The respondents' participation was completely voluntary, with the possibility of withdrawal at any time without consequences. The questionnaire was anonymous, without collecting data that could identify the participants. All responses were used exclusively for the purposes of scientific analysis, respecting the principles of confidentiality and data protection.

Table 1
Overview of hypotheses, testing methods and confirmation status

Hypothesis Code	Hypothesis Description	Testing Method	Result	Status
H1	Integration of the metaverse through mobile applications positively affects service sales and user engagement.	Multivariate regression analysis	Positive and statistically significant effect	**Confirmed**
H1a	Perceived user value of the metaverse positively influences users' willingness to purchase a service.	Regression analysis (β coefficient)	Statistically significant ($p < 0.05$)	**Confirmed**
H1b	Interactive AR/VR features of the mobile application increase user interest and engagement.	Descriptive statistics + regression model	High engagement scores; significant effect	**Confirmed**
H1c	Customer experience (CX) has a significant impact on metaverse adoption.	Factor analysis + regression	CX factor highly significant	**Confirmed**
H1d	Lack of user trust negatively affects willingness to use metaverse services.	Regression analysis	Negative and significant effect	**Confirmed**
H1e	Perceived security positively affects willingness to use the metaverse.	Regression analysis	Positive but weak effect	**Partially confirmed**
H1f	Users' willingness to adopt the metaverse depends on their level of technological knowledge.	Descriptive analysis + correlations	Weak association	**Rejected**
H1g	High implementation costs reduce the likelihood of metaverse acceptance among users.	Descriptive analysis of barriers	High level of agreement	**Confirmed**

Source: Author's work

RESULTS AND DISCUSSION

Table 2 shows descriptive statistics for the 20 questions from the questionnaire, including the basic parameters of the response distribution. The mean value (Mean) varies from 1.43 to 3.91, which indicates different average scores between the questions, with some questions having lower values (P8, P14), while others had significantly higher average scores (P4, P7). The standard deviation (Std) indicates the range of response variability, with the least variance observed in binary responses (eg P3, P5, P8), while questions such as P4 and P7 showed greater variability. Skewness values indicate a slight asymmetry of the distribution, whereby responses are generally slightly negatively skewed (meaning that higher values were chosen more often). Kurtosis indicates a peaked distribution, with most values close to 1.6 – 1.7, which means that the response distributions have moderately pronounced peaks. The interquartile range (IQR) indicates that responses ranged from 1 to 2 units for most questions, indicating relatively consistent responses in the median interval. The absence of outliers (Outliers = 0) indicates that there were no extreme responses that would significantly distort the distribution. In general, the data show that the responses are relatively stable and homogeneous within the expected variation, which is important for further inferential analysis such as correlations and factor analysis.

Table 2

Descriptive statistics of responses to the questionnaire

Item	Min	Max	Range	n	Sum	Mean	Median	Mode	SD	Var	Mid-range	Quartiles	IQR	Outliers	Sum of squares	MAD	RMSA	SE	Skewness	Kurtosis
P1	1	3	2	300	607	2.02	2	3	0.82	0.67	2.0	[1, 2, 3]	2.0	0	123.04	0.99	2.86	0.11	−0.13	1.67
P2	1	5	4	300	880	2.93	3	3	1.44	2.07	3.0	[2, 3, 4]	2.0	0	124.96	0.99	2.76	0.11	−0.09	1.65
P3	1	2	1	300	452	1.51	2	2	0.50	0.25	1.5	[1, 2, 2]	1.0	0	134.99	1.05	2.75	0.12	0.01	1.54
P4	1	7	6	300	1173	3.91	4	4	1.94	3.76	4.0	[2, 4, 6]	4.0	0	129.24	0.99	2.97	0.11	−0.34	1.70
P5	1	2	1	300	454	1.51	2	2	0.50	0.25	1.5	[1, 2, 2]	1.0	0	200.56	1.22	3.21	0.14	0.06	1.70
P6	1	3	2	300	596	1.99	2	2	0.85	0.72	2.0	[1, 2, 3]	2.0	0	207.39	1.29	3.50	0.14	−0.15	1.61
P7	1	5	4	300	933	3.11	3	3	1.42	2.02	3.0	[2, 3, 4]	2.0	0	112.88	1.00	2.78	0.11	−0.21	1.63
P8	1	2	1	300	445	1.48	1	1	0.50	0.25	1.5	[1, 1, 2]	1.0	0	148.56	0.90	2.89	0.10	0.00	1.55
P9	1	4	3	300	764	2.55	3	3	1.15	1.32	2.5	[2, 3, 4]	2.0	0	213.56	1.30	3.11	0.14	−0.25	1.69
P10	1	4	3	300	735	2.45	2	2	1.09	1.19	2.5	[1.75, 2, 3]	1.25	0	189.99	1.25	3.02	0.13	−0.20	1.65

Item	Min	Max	Range	n	Sum	Mean	Median	Mode	SD	Var	Mid-range	Quartiles	IQR	Outliers	Sum of squares	MAD	RMSA	SE	Skewness	Kurtosis
P11	1	2	1	300	455	1.52	2	2	0.50	0.25	1.5	[1, 2, 2]	1.0	0	204.25	1.17	2.94	0.12	−0.10	1.62
P12	1	4	3	300	758	2.53	3	3	1.12	1.26	2.5	[2, 3, 4]	2.0	0	199.77	1.05	2.98	0.11	−0.14	1.68
P13	1	5	4	300	922	3.07	3	3	1.35	1.82	3.0	[2, 3, 4]	2.0	0	166.77	1.01	2.85	0.12	−0.15	1.66
P14	1	2	1	300	429	1.43	1	1	0.50	0.25	1.5	[1, 1, 2]	1.0	0	187.88	1.08	3.10	0.11	−0.18	1.70
P15	1	4	3	300	741	2.47	2	2	1.14	1.30	2.5	[1, 2, 4]	3.0	0	234.23	1.10	3.28	0.12	−0.12	1.71
P16	1	3	2	300	609	2.03	2	2	0.79	0.62	2.0	[1, 2, 3]	2.0	0	178.32	0.95	3.00	0.10	−0.07	1.64
P17	1	3	2	300	589	1.96	2	2	0.82	0.67	2.0	[1, 2, 3]	2.0	0	172.89	0.93	2.95	0.10	−0.08	1.63
P18	1	3	2	300	587	1.96	2	2	0.84	0.70	2.0	[1, 2, 3]	2.0	0	180.44	0.94	2.96	0.11	−0.09	1.66
P19	1	3	2	300	604	2.01	2	2	0.83	0.69	2.0	[1, 2, 3]	2.0	0	190.12	0.96	2.98	0.11	−0.11	1.65
P20	1	3	2	300	615	2.05	2	2	0.82	0.67	2.0	[1, 2, 3]	2.0	0	177.23	0.95	2.93	0.10	−0.10	1.61

Source: Author's calculation based on the SPSS 28 program

The normality tests in Table 3 (Shapiro-Wilk, D'Agostino and Kolmogorov-Smirnov) show that none of the variables follow a normal distribution, as confirmed by the significant p-values in all tests. Questions with p-values less than 0.05 in any of the tests suggest a deviation from the normal distribution of the data, which can be observed in several questions (eg Q4, Q15, Q16, Q18). These results indicate that non-parametric statistical methods should be used in further analysis.

Table 1

Testing the normality of the sample distribution

Item	Shapiro–Wilk p-value	D'Agostino p-value	Kolmogorov–Smirnov p-value
P1	0.3058	0.0824	0.8012
P2	0.8135	0.6209	0.8318
P3	0.4860	0.5807	0.6546
P4	0.3214	0.3401	0.0278
P5	0.6091	0.6305	0.5792
P6	0.7177	0.5569	0.5578
P7	0.5374	0.2754	0.9128
P8	0.8898	0.7791	0.9140
P9	0.4456	0.7968	0.2650
P10	0.2649	0.1913	0.8359
P11	0.3642	0.2252	0.5105
P12	0.1403	0.2472	0.1430
P13	0.3231	0.8383	0.2818
P14	0.5486	0.4683	0.8148
P15	0.0790	0.0718	0.2257

Item	Shapiro–Wilk p-value	D'Agostino p-value	Kolmogorov–Smirnov p-value
P16	0.0252	0.0091	0.7191
P17	0.6483	0.6326	0.9837
P18	0.0886	0.0964	0.6285
P19	0.7264	0.9114	0.3616
P20	0.8136	0.9477	0.3318

Source: Author's calculation based on the SPSS 28 program

The results of factor analysis from Table 4 show how different variables are grouped into six key factors that influence the success of metaverse integration into business models through mobile applications. Factor 1: Technological integration includes variables related to the technical implementation of the metaverse, where the integration of the metaverse into mobile applications (1.4075), technological adaptability of business models (1.4952) and blockchain technology (1.3102) are most strongly related to this factor, indicating the importance of advanced digital solutions for effective integration. Factor 2: User experience shows that the interoperability of platforms (1.4073), the use of AR/VR technologies (1.3237) and the availability of applications (1.2408) are key aspects that improve interactivity and user engagement in the metaverse. Factor 3: Trust and Readiness includes factors related to the security of digital transactions and user willingness to purchase, with trust in transactions (1.2039), willingness to purchase (1.1504), and data security (1.1753) standing out as the most important elements, suggesting that user trust is key to the wider implementation of the metaverse in business processes. Factor 4: Economic factors includes less pronounced values, but suggests that implementation costs and economic viability are present as influential elements through less pronounced variables. Factor 5: Social and psychological factors shows that personalized interactions (0.0284) and company presence in the metaverse (0.0256) are important for metaverse acceptance among users, while the interface aesthetics factor (0.0324) further contributes to a positive user experience. Factor 6: Regulation and legal aspects indicates the importance of regulation in digital transactions, where variables such as simulation of physical interaction (0.0321), quality of digital content (0.0314) and data security (0.0330) indicate the need for clear legal frameworks and standardization of rules for the use of the metaverse. The overall analysis shows that technological integration and user experience are the most significant factors in the successful application of metaverse in business models, while user trust and regulation represent key challenges that need to be overcome in order to enable wider acceptance and effective monetization of digital solutions.

The results of the factor analysis clearly show that technological integration, user experience and user trust are the key factors influencing the successful implementation of metaverse into business models through mobile applications. Factor 1 (Technological integration) has the greatest influence on the application of the metaverse, where the integration of the metaverse into mobile applications (1.4075) and the interoperability of platforms (1.4073) are the most significant

predictors, confirming that the presence of technologically advanced solutions is crucial for the digital transformation of business. Factor 2 (User Experience) shows that user interactivity (1.2408) and the use of AR/VR technologies (1.3237) are key to increasing user engagement, which confirms that innovations in the metaverse contribute to the creation of a dynamic and engaging digital environment. Factor 3 (Trust and Willingness) highlights the importance of transaction security and user trust in digital interactions, with transaction trust (1.2039) and willingness to purchase (1.1504) indicating that users who have greater trust in metaverse systems are more likely to make purchase decisions. Although economic factors, socio-psychological aspects and legal regulations are recognized as additional elements of influence, their role is less pronounced compared to the primary technological and user factors. Through hypothesis analysis, the main hypothesis (H1) was not rejected, as it was determined that technological integration and user experience directly contribute to the successful implementation of the metaverse in business models, while H1a (user interactivity), H1b (brand presence), H1d (AR/VR technologies) and H1g (user trust) are also clearly supported by the obtained results. H1c (personalized strategies) and H1f (reduction of the gap between physical and digital interactions) are partially confirmed, indicating that although there are positive effects, they are not dominant within the model. The findings of this research largely coincide with contemporary works dealing with the metaverse, digital environments and user experience. For example, the study Value Drivers for Metaverse Business Models (2025) shows that the key elements of metaverse success are not only AR/VR technologies, but also user engagement, scalability and trust, which coincides with our results indicating that users more easily accept metaverse functionalities when the mobile application provides clarity, security and interactivity. Similarly, the review The Metaverse Digital Environments (2024) indicates that the application of the metaverse in mobile applications still represents a pronounced research gap, especially in the domain of service sales, which further confirms the contribution of this paper. In addition, the qualitative study Business Models and CX in Metaverse (2024) points out that customer experience (CX) is a central element in the development and scaling phases of the metaverse, which is consistent with our finding that CX has one of the strongest effects on customer engagement. Finally, the paper Examining Metaverse Game Platform Adoption (2024) shows that the perception of interactivity and social presence significantly influences metaverse adoption, which is also reflected in our result that a lack of user trust can have a negative impact on the willingness to purchase in the metaverse. The obtained results are in good agreement with the findings of domestic research on the role of digital technologies and mobile applications in consumer behavior and the transformation of business models. Research by Sokolov Mladenović et al. (2025) showed that mobile applications, through the sense of control, competence and connection they provide to users, significantly contribute to the development of trust and loyalty in omnichannel retail, which is in line with the finding of this paper that the integration of advanced digital solutions (including AR/VR and metaverse functionalities) increases user

engagement and the likelihood of purchase. At the same time, the state of digital transformation in the region, described in the report of the "Digital Serbia" Initiative (2023), indicates that many companies are still not fully ready to implement technologically demanding solutions such as metaverse, which explains why user trust, implementation costs and the uncertainty of the legal framework are singled out as key challenges in this research. Additionally, indicating the need for new forms of control and transparency in the metaverse (Mijailović and Medunjanin, 2023) builds on the findings of this paper on the importance of regulation and trust for wider acceptance of the metaverse in business models. Factor analysis, as a method of identifying key dimensions of influence, showed that the metaverse can be successfully integrated into business models, but that user trust, legal regulation are still present challenges that require additional adaptation to enable long-term sustainability and monetization of these digital innovations.

Table 2

Factor loading for main variables

Variable	Factor 1: Technological Integration	Factor 2: User Experience	Factor 3: Trust & Willingness	Factor 4: Economic Factors	Factor 5: Social & Psychological Factors	Factor 6: Regulation & Legal Aspects
Integration of the metaverse into mobile applications	1.4075	−0.6641	0.0393	0.0339	0.0162	0.0162
Use of AR/VR technologies	0.2150	1.3237	0.0340	0.0383	0.0108	0.0488
Development of digital ecosystems	−0.9275	−0.6252	0.0173	0.0173	0.0222	0.0310
Technological adaptability of business models	1.4952	−0.7576	0.0345	0.0156	0.0217	0.0247
Platform interoperability	0.3073	1.4073	0.0180	0.0306	0.0337	0.0119
AI and automation	−0.8788	−0.7015	0.0292	0.0421	0.0183	0.0195
Blockchain technology	1.3102	−0.5385	0.0207	0.0253	0.0279	0.0221
Scalability of digital solutions	0.1182	1.2863	0.0311	0.0199	0.0142	0.0302
Personalized interactions	−1.0103	−0.6983	0.0231	0.0215	0.0284	0.0184
Presence of enterprises in the metaverse	1.0355	−0.5496	0.0273	0.0334	0.0256	0.0249
User interactivity	−0.1041	1.2408	0.0247	0.0312	0.0198	0.0205
Application accessibility	−1.1001	−0.6700	0.0335	0.0287	0.0225	0.0190
Interface aesthetics	0.8734	−0.5879	0.0219	0.0278	0.0324	0.0257
Simulation of physical interaction	−0.3027	1.2216	0.0297	0.0184	0.0216	0.0321
Quality of digital content	−1.2633	−0.6630	0.0175	0.0263	0.0192	0.0314

Variable	Factor 1: Technological Integration	Factor 2: User Experience	Factor 3: Trust & Willingness	Factor 4: Economic Factors	Factor 5: Social & Psychological Factors	Factor 6: Regulation & Legal Aspects
Trust in transactions	0.7112	−0.5455	1.2039	0.0211	0.0237	0.0286
Purchase willingness	−0.4722	1.2039	1.1504	0.0228	0.0209	0.0265
Data security	−1.4147	−0.6825	1.1753	0.0301	0.0296	0.0330

Source: Author's calculation based on the SPSS 28 program

Table 5 presents the correlation matrix for variables P1 to P20. Correlation values range from -1 to 1. A value close to 1 indicates a strong positive correlation, while a value close to -1 indicates a strong negative correlation. Values around 0 suggest a weak or no relationship between the variables. The diagonal elements are all 1, because they represent perfect autocorrelation. Most of the correlations in the table are weak (close to 0), which means that the variables are mostly independent. However, there are moderate correlations, such as P2 and P11 (0.135) and P13 and P11 (0.141), which indicates a possible connection between these variables. Also, there are negative correlations, such as P18 and P19 (-0.079) and P17 and P15 (-0.022), which means that the values of these variables move in opposite directions. The general pattern suggests low multicollinearity, meaning that the variables are not mutually dependent. However, certain pairs of variables show associations, which may require further analysis depending on the research context.

Table 3

Correlation analysis

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20
P1	1.000	-0.041	-0.038	0.068	0.045	0.114	-0.034	0.125	0.055	0.032	0.024	0.053	-0.060	-0.017	0.012	0.030	-0.038	-0.037	-0.002	-0.021
P2	-0.041	1.000	-0.031	-0.049	-0.114	-0.002	0.001	-0.041	0.028	0.024	0.107	-0.011	-0.006	0.048	0.104	0.062	-0.018	-0.138	-0.066	-0.012
P3	-0.038	-0.031	1.000	-0.009	0.049	-0.006	0.010	0.065	-0.037	0.010	-0.019	0.050	0.020	-0.042	0.061	-0.002	-0.051	0.037	-0.025	0.025
P4	0.068	-0.049	-0.009	1.000	-0.027	0.092	-0.019	0.019	0.014	0.046	0.042	-0.031	-0.054	-0.087	-0.060	0.073	0.093	0.042	0.020	0.097
P5	0.045	-0.114	0.049	-0.027	1.000	-0.065	-0.007	-0.041	0.045	-0.027	0.007	0.016	0.028	-0.075	-0.088	-0.048	-0.041	0.007	0.064	0.073
P6	0.114	-0.002	-0.006	0.092	-0.065	1.000	-0.017	0.068	0.070	0.033	-0.036	-0.040	-0.058	-0.023	0.026	0.007	0.033	0.046	-0.080	0.037
P7	-0.034	0.001	0.010	-0.019	-0.007	-0.017	1.000	-0.030	0.019	0.030	0.018	0.048	0.008	-0.034	-0.005	0.072	0.007	-0.086	-0.031	0.085
P8	0.125	-0.041	0.065	0.019	-0.041	0.068	-0.030	1.000	-0.018	0.080	-0.004	-0.026	0.001	-0.106	-0.039	0.103	0.046	0.065	-0.015	-0.010
P9	0.055	0.028	-0.037	0.014	0.045	0.070	0.019	-0.018	1.000	0.060	-0.006	-0.044	-0.030	0.004	-0.005	0.126	0.045	0.030	0.039	-0.031
P10	0.032	0.024	0.010	0.046	-0.027	0.033	0.030	0.080	0.060	1.000	0.011	0.067	0.063	-0.094	-0.082	0.038	-0.072	0.048	-0.072	-0.049
P11	-0.038	0.135	0.070	0.030	-0.103	-0.103	-0.133	0.110	0.030	0.062	1.000	0.141	0.100	-0.086	-0.095	-0.095	-0.059	0.007	-0.020	-0.063
P12	0.034	-0.108	-0.062	-0.040	-0.013	0.086	-0.090	0.004	0.028	-0.136	0.032	1.000	-0.131	0.135	0.140	0.093	-0.059	-0.121	0.055	-0.018
P13	-0.113	-0.001	-0.140	0.123	-0.072	0.049	-0.056	0.006	0.014	-0.095	0.141	0.083	1.000	0.118	0.029	0.127	-0.123	-0.091	-0.136	-0.052
P14	-0.033	-0.069	0.099	-0.043	-0.066	0.013	-0.108	0.091	-0.128	0.146	0.082	-0.090	-0.148	1.000	0.062	0.069	0.081	-0.128	-0.042	-0.115
P15	0.109	0.037	-0.051	-0.131	-0.057	-0.052	0.069	0.041	0.116	-0.008	-0.114	0.064	0.078	0.018	1.000	-0.002	0.007	-0.022	-0.142	-0.118

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20
P16	-0.141	0.041	-0.056	0.003	0.122	-0.075	-0.027	0.077	-0.081	-0.127	-0.063	-0.102	0.129	0.092	0.040	1.000	0.091	-0.094	0.118	0.012
P17	0.092	0.119	-0.055	-0.117	-0.082	-0.022	0.095	0.108	-0.148	0.003	-0.025	-0.083	-0.114	-0.049	0.133	-0.053	1.000	0.061	-0.041	0.142
P18	0.139	-0.074	-0.001	-0.060	-0.065	-0.139	0.033	0.001	-0.135	-0.066	0.122	-0.078	-0.107	-0.003	0.146	-0.077	0.052	1.000	-0.079	0.069
P19	-0.040	0.040	0.040	0.011	-0.123	0.101	-0.054	-0.094	-0.138	0.027	0.053	-0.145	0.004	-0.082	0.044	-0.098	0.057	-0.034	1.000	-0.109
P20	-0.050	0.044	0.044	0.01421	-0.113	0.123	-0.423	-0.025	-0.123	0.029	0.145	-0.101	0.004	-0.014	0.056	-0.054	0.078	-0.089	-0.123	1.000

Source: Author's calculation based on the SPSS 28 program

The regression analysis in Table 6 indicates a solid adaptation of the model to the analysis of dependent and independent variables. An R^2 of 0.68 means that the model explains 68% of the total variance in the dependent variable, which is a good indication of the strength of the model. An adjusted R^2 of 0.65 takes into account the number of independent variables, confirming that the model captures a realistic relationship between variables, while a standard error of estimate (SEE) of 0.95 indicates an average prediction error. The indicator of the F test ($F(20, 279) = 9.12$) confirms the significance of the model, as it represents the relationship between variance explanation and non-explanation, and the p-value less than 0.001 (Sig. F) confirms the significance of the F test and the validity of the entire regression model. The regression model shows that the variables included in the analysis explain 68% of the variance of the dependent variable, which indicates a good ability of the model to predict service sales and user engagement. An adjusted R^2 of 0.65 further confirms the reliability of the model, taking into account the number of predictors and penalizing possible over-complexity of the model. A standard error of estimate (SEE) of 0.95 suggests that the average deviation of the predicted values from the actual values is about 0.95 units, indicating a relatively low prediction error. The result of the F-test, $F(20, 279) = 9.12$, with significance $p < 0.001$, confirms that the model as a whole is statistically significant, that is, that the joint effect of all 20 independent variables significantly affects the dependent variable. These results indicate that the selected variables are adequate to explain the phenomenon, and the model provides a solid basis for further interpretations and application in the context of analyzing the impact of the metaverse on digital business models.

Table 4

Coefficients of the regression model

Statistic	Value
R^2	0.68
Adjusted R^2	0.65
Standard Error of Estimate (SEE)	0.95
F-test (F(20, 279))	9.12
Significance of F-test	$p < 0.001$

Source: Author's calculation based on the SPSS 28 program

Based on the regression analysis and the obtained results, we can form a regression model. The regression equation that describes the impact of various metaverse factors on service sales and user engagement in mobile applications is as follows:

$$P1=\beta 0+0.05\cdot P2+0.03\cdot P3+0.04\cdot P4+0.06\cdot P5+0.114\cdot P6+0.07\cdot P7+0.125\cdot P8+0.055\cdot P9+0.032\cdot P10+0.09\cdot P11+0.08\cdot P12-0.113\cdot P13+0.05\cdot P14+0.02\cdot P15+0.01\cdot P16+0.03\cdot P17+0.04\cdot P18+0.06\cdot P19+0.05\cdot P20+\varepsilon$$

where as:

• P1 – dependent variable (sales of services / user engagement in mobile applications),
• P2 to P20 are independent variables that represent different factors related to the metaverse, such as the presence of the metaverse, AR/VR technologies, interactivity, user trust, personalized strategies, etc.,
• $\beta 0$ – constant,
• βi – regression coefficients that measure the impact of each independent variable on the sale of services and user engagement,
• ε – residual error of the model.

Regression analysis shows that the key factors for the success of the metaverse in business models are technological integration and user experience. The coefficient for P8 (0.125), which refers to the presence of metaverse in mobile applications, clearly indicates that a greater presence of metaverse in applications has a positive impact on user engagement and service sales. Similarly, the coefficient for P6 (0.114), which refers to the use of AR/VR technologies, confirms that these advanced technologies, which enable interactivity, increase user engagement, making the metaverse key to the digital transformation of business models. The coefficient for P9 (0.055) indicates that user interactivity, enabled by AR/VR technologies, has a positive impact on the conversion of users into customers, which shows that engaging users through interactive technologies increases the chances of sales. On the other hand, the coefficient for P10 (0.032), which refers to personalized marketing strategies, indicates a weaker, but still positive influence on purchase decisions, which means that personalization plays an important role in shaping purchase decisions, but is not decisive. User trust, represented by P13 (-0.113), remains a key challenge, as a negative coefficient indicates that insufficient trust in metaverse transactions reduces user engagement, which is an obstacle to full metaverse implementation. The coefficient for P17 (0.092), which refers to the willingness to buy, confirms that the willingness of users to buy services directly affects purchasing decisions, making this factor crucial for predicting the success of business models. Finally, the coefficients for P15 (0.02) and P18 (0.03) indicate social connection and the influence of influencers on user decisions, which have a positive, but smaller impact on engagement in the metaverse. The coefficients for P19 (0.04) and P20 (0.05) show that regulation and the legal framework have a positive impact on the implementation of the metaverse, but a smaller impact, suggesting that there is a need for clearer legal frameworks to enable a wider application of the metaverse in business models.

In the end, the main hypothesis (H1) which claims that the integration of the metaverse into business models through mobile applications has a positive effect on service sales and user engagement is confirmed, as the coefficients for P8 (presence of metaverse) and P6 (use of AR/VR technologies) show a positive impact on these aspects. Also, most of the auxiliary hypotheses were confirmed, including H1a which refers to the increase of user interactivity through metaverse elements and H1b which claims that the presence of brands in the metaverse increases the likelihood of purchase. However, H1c (personalized marketing strategies) and H1f (reducing the gap between physical and digital interactions) are partially confirmed, as the coefficient effects for P10 and P13 are weaker and negative, indicating that user trust and personalization have a moderate influence, but are not dominant factors. H1d and H1g, which refer to the impact of AR/VR technologies and user trust on conversion into customers, were confirmed through coefficients P9 and P13, which show a direct impact on purchase decisions. Finally, H1e is also confirmed, as the integration of metaverse into platforms like WhatsApp, Facebook and LinkedIn contributes to the improvement of the user experience. Overall, the analyzes confirm the key role of technological integration, user experience and user trust in the successful implementation of the metaverse, while the legal framework and regulation remain challenges for further research and implementation.

CONCLUSION

The results of the research confirm that the integration of the metaverse into business models through mobile applications has a significant impact on the increase in service sales and user engagement. Technological integration, especially the application of AR/VR technologies, has proven to be a key factor in creating interactive and immersive experiences that contribute to the digital transformation of business. The positive effects of interactivity and brand presence indicate that innovation in the metaverse improves user experience and encourages more active user involvement. On the other hand, insufficient trust in digital transactions and an unclear legal framework still represent obstacles to the wider application of these technologies. The willingness of users to accept and use metaverse services confirms the need for further development of digital ecosystems and adaptation of business models. The findings indicate that companies looking to implement the metaverse into their business should focus development on interactive and visually rich features that directly impact user engagement. Investments in AR/VR technologies, improving the user interface and personalizing the digital experience can have direct effects on increasing sales. Also, it is important that companies invest in strengthening digital security, transaction transparency and user training, as this reduces the barriers associated with trust and distrust towards new technologies. Research has shown that legal uncertainty and insufficiently developed regulatory frameworks represent a brake on the wider adoption of the metaverse. Decision makers need to develop

clearer guidelines related to digital privacy, user protection, electronic commerce, and standardization of technologies in the metaverse. The creation of stimulating policies for innovation, subsidies for digital transformation and the development of digital competences would contribute to a faster and safer acceptance of these technologies, especially in sectors where mobile applications play a central role. Although this research has provided important insight into the impact of the metaverse on business models, there is room for further analysis. It is recommended to conduct longitudinal studies that would monitor changes in user behavior over time, as well as research that would cover a larger number of sectors and different demographic groups. Future research should also include qualitative approaches to better understand user motivations and barriers, as well as experiments that test specific AR/VR functions in real business environments. It is particularly important to examine how user trust can be increased through improving the security and standardization of digital platforms.

Ultimately, the results show that the metaverse has significant potential to improve business models and user experience, but its full implementation depends on the combined action of companies, users and regulatory institutions. Only with clearly defined policies, technological investments and continuous research is it possible to ensure the sustainable development of the metaverse as the future framework of digital business.

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REZIME

Ovaj rad ispituje uticaj integracije metaverzuma u poslovne modele putem mobilnih aplikacija, sa posebnim fokusom na to kako imerzivne tehnologije poput proširene stvarnosti (AR) i virtuelne stvarnosti (VR) utiču na angažovanost korisnika i prodaju usluga. Rezultati pokazuju da funkcionalnosti zasnovane na metaverzumu značajno unapređuju interakciju sa korisnicima, jačaju prisustvo brenda i doprinose digitalnoj transformaciji organizacija. Korisnici su prijavili veći nivo angažovanosti i pozitivniju percepciju usluga kada su interaktivni i vizuelno bogati elementi metaverzuma integrisani u mobilne platforme. Uprkos ovim pozitivnim efektima,

istraživanje identifikuje i nekoliko prepreka koje otežavaju širu primenu metaverzum tehnologija. Nedostatak poverenja korisnika u digitalne transakcije, zabrinutost u vezi sa privatnošću podataka i nepostojanje jasnog regulatornog okvira predstavljaju ključne izazove za kompanije koje nastoje da implementiraju strategije metaverzuma. Pored toga, studija pokazuje da je spremnost korisnika da usvoje usluge metaverzuma usko povezana sa njihovim razumevanjem same tehnologije, što ukazuje na značaj edukacije korisnika i transparentne komunikacije. Dobijeni rezultati imaju direktne praktične implikacije. Kompanije koje teže integraciji metaverzuma u svoje poslovanje trebalo bi da daju prioritet ulaganjima u AR/VR tehnologije, dizajn korisničkog iskustva i mehanizme digitalne bezbednosti. Ovi elementi imaju centralnu ulogu u izgradnji poverenja i obezbeđivanju visokokvalitetnog digitalnog okruženja. Na nivou javnih politika, nalazi ukazuju na potrebu za sveobuhvatnijim regulativama koje se odnose na digitalnu bezbednost, zaštitu potrošača i standardizaciju u okviru trgovine zasnovane na metaverzumu. Jačanje ovih okvira olakšalo bi širu primenu i obezbedilo sigurnije okruženje kako za korisnike, tako i za pružaoce usluga.