UDC 004.77:005.412

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THE IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGIES ON ENTREPRENEURIAL ACTIVITY IN UKRAINE

Annotation. This article examines the specific influence of information and communication technologies (ICT) on the state of entrepreneurial activity and the dynamics of business development in Ukraine. It highlights the correlation between the general spread of ICT, their integration into business operations, and the profitability and competitiveness of enterprises. **The aim** is to determine the relationship between the population's digital literacy in Ukraine, the level of entrepreneurial activity, and business performance. **Methodology**. The methodological foundation is based on contemporary global and Ukrainian economic thought regarding ways to stimulate entrepreneurship and improve business profitability through the implementation of digital technologies. The research applies methods of analysis and synthesis, generalization, comparison, systematization, as well as correlation and regression analysis using the SPSS (Statistical Package for the Social Sciences) software. **Results.** The study allowed for the systematization of scientific approaches to the positive impact of digital technologies on entrepreneurship and, through appropriate methodological tools, revealed specific trends and patterns relevant to Ukraine. **Scientific novelty** lies in the application of modern quantitative analysis tools to identify the correlation between digital skills among the population, the potential for business expansion, increased profitability, and innovation. **Practical significance** of the research is in identifying key digital technological factors that stimulate entrepreneurial activity. These findings can be applied by entrepreneurs, governmental institutions, and other organizations in the context of Ukraine's post-war economic recovery.

Keywords: digitalization; information and communication technologies; entrepreneurial activity; business performance; Ukrainian economy

Statement of the problem

The impact of ICT on entrepreneurship is widely recognized globally, emphasizing its crucial role in fostering innovation, stimulating business activity, and enhancing enterprise efficiency and competitiveness. However, the specific features of ICT's influence on entrepreneurship in Ukraine remain insufficiently underexplored. Understanding how ICT affects entrepreneurial activity is essential for identifying opportunities to expand the innovation potential of Ukrainian businesses and to strengthen their profitability and sustainable development. This study aims to fill the gap in academic research on these issues by identifying a positive correlation between ICT diffusion, the development of entrepreneurial initiatives, and enterprise profitability in Ukraine. The focus is placed on the factors that either facilitate or hinder this relationship within the broader context of post-war recovery and sustainable economic development in Ukraine.

Analysis of recent research and publications

The impact of ICT on entrepreneurship, business operations, and enterprise competitiveness has been comprehensively studied by scholars such as Volot O., Duong C.D., Barnett W.A., Kotnik P., Stritar R., Obikhod S.V., Berestetska O., Riznyk N., Kukhar A., Svirska V., Vasylenko V., Skinner G., Afawubo K., Noglo Y., Robert F., Yunis M., Abdullah T., and others. Recent research highlights the multifaceted role of ICT in fostering entrepreneurship and improving enterprise performance. Duong C.D. et al. [6] demonstrated how ICT skills enhance creativity, positively influencing digital entrepreneurial attitudes and intentions, while noting the mediating role of creativity in overcoming technological anxiety. Barnett W.A. et al. [3] identified significant correlations between ICT use, such as mobile phones and internet access, and entrepreneurial engagement in rural China, emphasizing the role of social networks as mediators. Similarly, Kotnik P. and Stritar R. [10] observed that higher ICT usage drives increased business entry rates, affirming ICT as a key enabler of reduced transaction costs.

DOI: https://doi.org/10.15802/rtem2025/338827

Afawubo K. and Noglo Y. [2] expanded the analysis to a global scale, showing that ICT assets positively impact entrepreneurship in 59 countries, with developing and emerging economies benefiting the most. In contrast, Abdullah T. et al. [1] focused on microenterprises, finding that limited ICT knowledge and skills remain significant barriers to effective ICT adoption and hinder competitiveness.

These findings collectively underline ICT's transformative potential in enhancing entrepreneurial activity, though challenges in adoption, especially in microenterprises, continue to require targeted interventions.

Formulation of the purpose of the article

The aim of this article is to determine the correlation between the spread of modern information and communication technologies in Ukraine, their integration into economic activity, and their positive impact on entrepreneurship – in particular, on entrepreneurial activity, enterprise profitability, and competitiveness – within the broader context of post-war recovery and the sustainable development of the national economy.

The main material of the research

ICT are significantly transforming business operations. ICT enables the emergence of new business models, management approaches, and communication methods. The integration of ICT becomes a competitive advantage, allowing companies not only to automate processes and streamline operations, but also to expand their markets and establish flexible connections with customers and partners. Digital tools foster entrepreneurial creativity and adaptability, both of which are crucial for success in an era of rapid technological change.

Several studies have examined the interdependencies, causal relationships, and correlations that arise in entrepreneurship due to the influence of ICT through empirical analysis, testing, and modeling. Building on the work of Duong, Barnett, Kotnik, and Stritar, this study aims to conduct a similar analysis of the level of ICT usage in Ukrainian entrepreneurship. Within this study, the level of entrepreneurial activity is defined as the ratio of all active business entities (including individual entrepreneurs and enterprises, excluding large corporations) to the total population, expressed as a percentage. The increase in business profitability is measured as the average annual growth. To achieve this goal, data on the status and performance indicators of entrepreneural activity in Ukraine were used, as published by the State Statistics Service of Ukraine, Eurostat, and the World Bank for the period 2010-2022 were utilized. The collected data were organized into an Excel database for subsequent correlation and regression analysis, which was then imported into SPSS (Statistical Package for the Social Sciences), a widely used software tool in social science research that provides various analytical techniques, including descriptive statistics, regression, and correlation analysis, to examine relationships between variables [15].

ICT's rapid development drives entrepreneurship and economic resilience, especially in developing countries like Ukraine. While data on ICT in Ukraine is limited, selected independent variables help analyze the link between ICT growth and entrepreneurial activity. On the basis of the literature and available data, the chosen independent variables are *Capital Investments in Software, Internet Penetration, Enterprise Internet Access, E-GDP, Mobile Phone Subscriptions, Social Media Penetration in Enterprises, Cloud Technology Penetration, Digital Transaction Volume, Network Readiness Index, and E-commerce Sales* (table 1).

These variables are reveal the level of digital adoption among businesses and how ICT contributes to economic growth and competitive advantages.

In this study, the selected ICT variables were used as independent variables to test their correlation with two dependent variables and the significance of these relationships: *the growth of business profitability* [14] and *the level of entrepreneurial activity* (calculated as the share of entrepreneurs and enterprises to the total population) [12, 13].

DOI: https://doi.org/10.15802/rtem2025/338827

Table 1

ICT independent variables

Source: Author's own elaboration [based on data from sources 4-5, 7-9, 11-14, 16-28]

Variable	Explanation
Capital Investments in Software	Reflects company spending on software (in thousand UAH) and indicates the level of technological adoption and digital transformation efforts [4].
Internet Penetration	Percentage of the population with internet access essential for digital economy development and online business interactions [8,9].
Enterprise Internet Access	Percentage of companies with internet access; fundamental for digital transformation, online commerce, and operational efficiency [28].
E-GDP	Percentage of GDP generated by e-commerce and online platforms; indicates the economic contribution of digital technologies [7].
Mobile Phone Subscriptions	Number of mobile subscriptions per 100 inhabitants; essential for ICT infrastructure and digital communication, especially in regions with limited fixed internet access [11].
Social Media Penetration in Enterprises	Percentage of companies using social media for business purposes; reflects digital marketing adoption and customer interaction [27].
Cloud Technology Penetration	Percentage of companies using cloud services; crucial for scalability, data storage, and IT infrastructure efficiency [26].
Digital Transaction Volume	Value of transactions conducted through digital services (in billions USD); indicates the acceptance of cashless systems and operational efficiency [5].
Network Readiness Index	Measures a country's readiness for ICT use, considering infrastructure, digital skills, and regulation (0-100 scale). Reflects overall capacity to integrate digital technologies across sectors [17, 18, 19, 20, 21, 22, 23, 24, 25].
E-commerce Sales	Revenue from e-commerce sales (in thousand UAH); shows the scale of digital sales channels and consumer readiness for online shopping [16].

Descriptive statistics (table 2) help identify trends over time, assess ICT adoption levels, and observe fluctuations or stable patterns from 2010 to 2022. Additionally, analyzing changes in profitability and entrepreneurial activity provides context for understanding their relationship with ICT variables.

Table 2

Descriptive statistics

Source: Author's own elaboration [based on data from sources 4-5, 7-9, 11-14, 16-28]

Indicator	Observations (n)	Min Value	Max Value	Mean Value	Standard Deviation
Growth in Enterprise Profitability	13	-4.056	12.588	5.56896	4.240413
Number of Business Entities	13	1,600,304	2,164,105	1,863,839.77	153,618.826
Level of Entrepreneurial Activity	13	3.51	4.75	4.2909	0.40578
Capital Investments in Software	11	1,850,031	9,612,585	4,852,783.18	2,473,780.72
Internet Penetration (Population)	13	23.3	79.218	53.38290	18.115676
Internet Penetration (Businesses)	4	85.100	88.000	86.52500	1.187083
E-GDP	8	1.270	2.100	1.84125	0.289504
Mobile Subscriptions per 100 Inhabitants	12	117.768	144.279	131.88059	7.598378
Network Readiness Index	10	35.300	55.710	43.895	7.871304
Social Media Penetration (Businesses)	3	29.1	30.131	29.65070	0.518938
Cloud Technology Adoption (Businesses)	4	9.8	10.3	10.025	0.262996
Volume of Digital Transactions	6	2.750	10.050	6.38500	3.054844
E-commerce Sales Volume	5	228,035,635	465,316,899	357,313,151	98,461,076.6

DOI: https://doi.org/10.15802/rtem2025/338827

The following analysis provides a detailed overview of key variables, highlighting their central tendencies, variability, and trends over the studied period to assess the role of ICT in shaping Ukrainian entrepreneurship and business performance:

- Enterprise profitability growth: average annual change of 5,57% with moderate variability (Standard Deviation (SD) = 4,24). Profitability ranged from -4,06% to 12,59%, reflecting economic fluctuations;
- Entrepreneurs: business entities ranged from 1,600,304 to 2,184,105, with a stable average of 1,863,840 (SD = 153,618.83);
- Level of Entrepreneurial Activity: average of 4,29% with low variability (SD = 0,41), indicating a steady level of entrepreneurial activity (range: 3,51-4,75%);
- Software investments: significant variability (mean: 4,85M UAH, SD = 2,47M, range: 1,85M-9,61M UAH), indicating that enterprises have different strategies, resources, and levels of readiness for digital transformation;
- Internet penetration: grew steadily from 23,3% to 79,2%, with an average of 53,38% (SD = 18,12);
- E-GDP: limited contribution to GDP, but showing gradual growth (mean: 1,84%, SD = 0,29; range: 1,27-2,1%);
- Mobile subscriptions (per 100 inhabitants): high and stable (mean: 131,88, SD = 7,6, range: 117,77-144,8);
- Network readiness index: moderate progress in ICT readiness (mean: 43,9, SD = 7.87; range: 35,3-55,71);
- Social media penetration (businesses): stable at 29,65% (SD = 0,52; range: 29,1-30,13%);
- Cloud technology adoption (businesses): low, but stable (mean: 10,03%, SD = 0,26; range: 9,8-10,3%);
- Digital transactions: moderate variability (mean: $6,39B, SD = $3,05B; range: $2,75B-$10,05B) reflects growing digital activity;
- Internet penetration (businesses): near-universal usage (mean: 86,53%, SD = 1,19; range: 85,1-88%);
- E-Commerce sales: significant growth and variability (mean: 35.73B UAH, SD = 9,85B; range: 22,8B-46,5B UAH).

These descriptive statistics provide an essential overview of Ukraine's ICT landscape, highlighting the adoption and economic impact of digital technologies and laying the groundwork for further analysis of their influence on business performance and entrepreneurship.

The relationship between ICT factors and profitability growth or level of entrepreneurial activity is examined, highlighting the potential role of digital investments in fostering business growth and innovation.

This research uses correlation analysis to explore the relationship between ICT variables and two key economic indicators: the growth of business profitability and the level of entrepreneurial activity. Understanding these connections can highlight the role of digital investments in driving business growth and innovation. To explore the relationship between ICT variables and profitability growth, a univariate correlation analysis was first conducted. Table 3 provides insight into which ICT variables show a statistically significant positive correlation with profitability growth at a 0,05 significance level.

Table 3

The results of the correlation between profitability and ICT variables

Source: Author's own elaboration [based on data from sources 4-5, 7-9, 11-14, 16-28]

Variable	Pearson Correlation	Significance Level	Sample Size (N)
Profitability Growth	1.000	-	13
Capital Investments in Purchased Software	0.674	0.012	11
Internet Penetration among the Population	0.469	0.053	13
Internet Penetration among Enterprises	-0.265	0.368	4
E-GDP	0.471	0.120	8
Mobile Subscription per 100 Inhabitants	-0.416	0.089	12
Network Readiness Index	0.580	0.040	10
Social Media Penetration (Enterprises)	0.995	0.032	3
Cloud Technology Penetration (Enterprises)	0.785	0.108	4
Volume of Digital Transactions	-0.108	0.419	6
Sales via E-commerce	-0.223	0.359	5

DOI: https://doi.org/10.15802/rtem2025/338827

The analysis reveals that several ICT-related factors demonstrate a positive correlation with profitability growth. Specifically, investments in software, with a correlation coefficient of 0,674, the Network Readiness Index (NRI) at 0,58, social media penetration among companies at 0,995, and internet penetration among the general population at 0,469, all show significant positive relationships with profitability growth. These findings suggest that strategic ICT investments, along with broader digital integration within businesses, play a crucial role in enhancing profitability.

The particularly strong correlation with social media penetration highlights how companies' engagement with digital platforms can drive business performance. Furthermore, the notable connection between internet penetration and profitability emphasizes the fundamental importance of internet access for business operations. The widespread availability of the internet not only facilitates efficient communication and operations but also creates new avenues for business innovation and growth. This underlines the essential role of ICT infrastructure in supporting profitability and demonstrates that businesses relying on digital technologies are likely to experience improved financial outcomes.

The next part of the analysis focuses on the relationship between ICT variables and the *level of entrepreneurial activity*. A distinct univariate correlation analysis was conducted to investigate this relationship, with the results outlined in the table below. This analysis seeks to identify the impact of various ICT factors on entrepreneurial activity, offering insights into how digital technologies influence the dynamics of entrepreneurship and contribute to its growth or limitations (table 4).

Table 4

The results of the correlation between the level of entrepreneurial activity and ICT variables

Source: Author's own elaboration [based on data from sources 4-5, 7-9, 11-14, 16-28]

Variable	Pearson Correlation	Significance (One-Tailed)	Sample Size (N)
Level of Entrepreneurial Activity	1.000	-	13
Capital Investments in Purchased Software	0.619	0.021	11
Internet Penetration among the Population	0.491	0.044	13
Internet Penetration among Enterprises	-0.460	0.270	4
E-GDP	0.079	0.426	8
Mobile Subscription per 100 Inhabitants	-0.026	0.468	12
Network Readiness Index	0.279	0.218	10
Social Media Penetration (Enterprises)	0.952	0.099	3
Cloud Technology Penetration (Enterprises)	0.918	0.041	4
Volume of Digital Transactions	0.280	0.295	6
Sales via E-commerce	-0.01	0.499	5

At a 0,05 significance level, the analysis revealed positive correlations between the level of entrepreneurial activity and certain ICT variables, including investments in purchased software (correlation coefficient 0,619), internet penetration among the population (0,491), and the adoption of cloud services among businesses (0,918). These findings suggest that higher levels of entrepreneurship are associated with greater internet accessibility and the integration of cloud services, both of which lower entry barriers and equip entrepreneurs with tools to enhance operational efficiency and scale their businesses.

The strong positive correlation with internet penetration further emphasizes the critical role of internet access in fostering entrepreneurship. The availability of reliable and widespread internet provides entrepreneurs with essential resources, enabling them to reach broader markets, improve business processes, and adopt innovative technologies. Additionally, the adoption of cloud services among businesses appears to offer significant advantages, such as cost reduction, flexibility, and improved collaboration, which are key factors in supporting entrepreneurial growth and competitiveness. These results highlight the importance of digital infrastructure – a set of technological tools and systems that provide access to digital services, including communication networks, cloud platforms, and software – in creating a favorable environment for entrepreneurship development and the implementation of innovations.

After identifying the ICT variables correlated with profitability and level of entrepreneurial activity, a multiple regression analysis was performed to explore these relationships further. Unlike correlation analysis, regression assesses the combined effect of multiple variables on a dependent variable, providing

DOI: https://doi.org/10.15802/rtem2025/338827

insights into each ICT variable's unique contribution. This approach also helps detect multicollinearity and improves prediction accuracy with R^2 values. The following analysis outlines the regression models used to assess profitability, emphasizing the ICT factors with the greatest impact on Ukraine's business environment.

The multiple regression analysis, with profitability growth as the dependent variable and software investments, the NRI, social media penetration among companies, and internet penetration among the population of Ukraine as independent variables, is presented in the table 5.

Table 5

Regression analysis of profitability as the dependent variable

Source: Author's own elaboration [based on data from sources 4-5, 7-9, 11-14, 16-28]

Variable	Unstandardized B	Standard Error of Coefficients	Standardized B	t	Significance	Collinearity Tolerance	VIF
Constant	-300.430	134.878		-2.22	0.57		
Capital Investments in Purchased Software	1.275E-6	0.000	0.679	1.65	0.136	0.249	4.01
Network Readiness Index	0.139	0.340	0.223	0.40	0.695	0.140	7.16
Social Media Penetration (Enterprises)	9.979	4.432	0.499	2.25	0.054	0.853	1.17
Internet Penetration among the Population	-0.040	0.089	-0.171	-0.45	0.663	0.291	3.43

The coefficient table reveals the individual impact of each independent variable on profitability growth:

- Software investments show a positive standardized coefficient (Beta = 0,679), but with a significance level of (p = 0,136), indicating a positive relationship with profitability, though not statistically significant at the 0,05 level. This suggests that while software investments may have a positive effect, their impact is inconsistent across cases;
- Network Readiness Index (NRI) also shows a positive standardized coefficient (Beta = 0,223), but is not statistically significant (p = 0,695). The relatively high Variance Inflation Factors (VIF) – 7,167 points to potential multicollinearity, indicating a possible interdependence with other predictors;
- Social media penetration among companies demonstrates a strong positive effect with a standardized coefficient (Beta = 0,499) and significance near the threshold (p = 0,054). This suggests that social media penetration could significantly influence profitability growth, with its impact being the most notable among the predictors, though it falls just short of statistical significance;
- Internet penetration shows a negative standardized coefficient (Beta = -0,171) and lacks statistical significance (p = 0,663), indicating no clear or positive effect on profitability growth.

The VIF range from 1,173 to 7,167, with NRI showing a relatively high VIF, pointing to moderate multicollinearity. While this does not invalidate the model, it warrants careful interpretation of NRI's unique effect due to potential overlap with other predictors.

This research highlights the crucial role of ICT investments in driving economic growth, particularly through increased business profitability and the stimulation of entrepreneurial activity. The analysis shows positive correlations between ICT factors, such as software investments, social media penetration, and internet access, with profitability. Companies actively engaging in digital marketing via social media can achieve higher financial returns, while internet access remains vital for business growth.

Similarly, the level of entrepreneurial activity correlates with software investments, cloud technology, and internet penetration. Cloud tools reduce operational barriers, supporting startups, while internet access is critical for new businesses.

Regression analysis reveals that ICT investments, especially in digital customer engagement and internet access, significantly impact profitability. Social media penetration has the strongest effect, but internet access alone may not drive profitability without integrated digital strategies.

DOI: https://doi.org/10.15802/rtem2025/338827

For entrepreneurs, the results stress the importance of investing in digital tools that enhance customer interaction and operational efficiency, such as social media and cloud technologies. Although ICT investments alone cannot fully explain the level of entrepreneurial activity – as it also depends on factors such as government policy, education level, access to financing, market environment, and entrepreneurial culture – additional support measures, including incentives for software adoption and entrepreneurship development programs, can significantly strengthen this sector.

In addition to expanding access to high-quality internet, building a digital-proficient workforce is crucial for maximizing the benefits of ICT. By investing in digital education and creating supportive ecosystems for digital entrepreneurship, policymakers and business leaders can ensure that both existing and emerging businesses are equipped to thrive in an increasingly digital economy. Strengthening digital infrastructure and the digital competencies of employees and entrepreneurs will not only increase business profitability but also contribute to long-term sustainable growth across various sectors of the Ukrainian economy, as evidenced by the identified correlations between ICT factors and key indicators of entrepreneurial activity and financial performance.

The research faces limitations related to data availability, particularly on emerging technologies like Enterprise Resource Planning (ERP), Customer Relationship Management (CRM) and Artificial Intelligence (AI). Since these technologies are relatively new, their usage has often not been systematically tracked, making it difficult to conduct thorough analysis. Additionally, the existing statistical data covered only a relatively short period of time.

Conclusions

The research findings confirm a positive correlation between specific ICT-related variables – in particular, capital investments in software, social media penetration, the network readiness index, and Internet penetration – and the increase in enterprise profitability in Ukraine. Similarly, the level of entrepreneurial activity shows a positive correlation with Internet penetration among the population, the use of cloud technologies, and digital capital investments, indicating a favorable impact of digital transformation on entrepreneurial development.

Regression analysis revealed that, among all examined variables, social media penetration and investments in software are the most influential in determining enterprise profitability, although their statistical significance requires further validation on larger samples.

The analysis also showed that Internet access alone does not guarantee improved financial performance unless accompanied by the development of a comprehensive digital strategy. Such a strategy should include the integration of modern tools for digital interaction, automation, and data analytics.

The integration of ICT into entrepreneurship not only enhances business profitability but also contributes to broader economic development, positioning Ukraine – in the context of post-war recovery – as a potential leader in digital entrepreneurship on the global stage. Future research should focus on identifying and overcoming barriers to digital adaptation and assessing the long-term impact of ICT-driven changes on entrepreneurship. This will allow for a deeper understanding of how to enhance business competitiveness and support the sustainable economic development of Ukraine in the era of digital transformation.

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ВПЛИВ ІНФОРМАЦІЙНО-КОМУНІКАЦІЙНИХ ТЕХНОЛОГІЙ НА ПІДПРИЄМНИЦЬКУ АКТИВНІСТЬ В УКРАЇНІ

Анотація. У статті розглянуто особливості впливу інформаційно-комунікаційних технологій (ІКТ) на стан підприємницької діяльності та динаміку підприємницької активності в Україні. Відображено зв’язок між загальним поширенням ІКТ, їх запровадженням до бізнес-діяльності, прибутковістю та конкурентоспроможністю підприємств. **Мета полягає** у визначенні кореляції між станом оволодіння населенням України новітніми цифровими технологіями, рівнем підприємницької активності та ефективності ведення бізнесу. **Методика.** Методологічною базою слугують актуальні положення сучасної світової та

DOI: https://doi.org/10.15802/rtem2025/338827

української економічної думки щодо напрямів стимулювання підприємницької діяльності та покращення дохідності підприємств через запровадження інформаційно-цифрових технологій. У процесі дослідження використовувались методи аналізу і синтезу, узагальнення, порівняння та систематизації, кореляційного і регресійного аналізу на основі застосування програмного інструментарію SPSS (Statistical Package for the Social Sciences). **Результати.** Проведене дослідження дало змогу упорядкувати наукові підходи щодо позитивного впливу поширення цифрових технологій на стан підприємництва та, через застосування відповідного методичного інструментарію, з'ясувати його особливості в Україні. **Наукова новизна** статті полягає у застосуванні актуальних інструментів кількісного аналізу для визначення взаємозв'язку між станом оволодіння населенням новітніми цифровими технологіями, потенціалом розширення бізнесу, зростанням його дохідності та інноваційності. **Практичне значення** дослідження полягає у визначенні ключових цифрових технологічних чинників стимулювання підприємницької активності, які можуть бути використані підприємцями, державними інституціями та іншими організаціями для у контексті повоєнного відновлення економіки України.

Keywords: цифровізація; інформаційно-комунікаційні технології; підприємницька активність; ефективність діяльності підприємств, економіка України.

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Стаття надійшла до редакції: 01.05.2025
Received: 2025.05.01

