

The role of digital transformation in the formation and development of intellectual capital in telecommunications companies

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Abstract. The study aimed to determine how the introduction of digital technologies changes the components of telecommunications companies' intellectual capital and affects their efficiency and economic performance. To study the digital transformation of telecommunications companies, data analysis methods, integration of analytical and artificial intelligence platforms, assessment of the impact of the Internet of Things, cloud services and digital ecosystems on the efficiency of business processes, personalisation of services and development of intellectual capital were used. The study determined that in 2025, the number of Internet users worldwide reached about 6 billion people (72% of the population), while in Ukraine, this figure was 31.5 million people (82.4% of the population). The study determined that the structural capital of telecom operators has strengthened thanks to process automation, the introduction of cloud platforms and data analytics; 85% of operators consider digitalisation critical to growth, 70% reported increased network productivity, and operating costs fell by 15-20%. The study also found that customer capital has been transformed through service personalisation, self-service platforms, and the integration of the Internet of Things. The study determined that Kyivstar increased service efficiency with digital revenue in 2025 increased 4.7 times to USD 124 million (a 4.9-fold increase to UAH 5.2 billion) and reached 10.7% of total revenue. In the fourth quarter of 2025, revenue from digital services grew 6.1 times to USD 50 million (a 6.4-fold increase to UAH 2.1 billion) and accounted for 15.7% of total revenue. The share of multiplay users increased 18.0% year-on-year to 7.3 million, representing 35.0% of active monthly mobile subscribers. The study showed that Vodafone invested more than UAH 6 billion in network modernisation and deployed 7,252 LTE stations. The study determined that Lifecell increased Internet speed by 20-30%. These changes strengthened human, structural, and customer capital and supported the innovative development of telecom operators. The practical significance of the study is determined by the applicability of the results in the development of effective strategies for the digital transformation of telecommunications companies and improving the effective management of their intellectual capital

Keywords: cloud technologies; automation; innovation; personalisation; productivity; subscriber loyalty

Introduction

Telecommunications companies operate in a rapidly changing technological environment, where the implementation of digital solutions is becoming a key factor in development. Digital tools enable companies to optimise their operations, improve process efficiency and create new services for users. In such conditions, intellectual capital becomes a strategic resource that ensures a company's ability to innovate, adapt to change and maintain competitiveness in the market.

Research shows that the digital transformation of the telecommunications industry has a multi-vector impact that encompasses the technological base, staff competencies, approaches to customer service, and the strategic sustainability of business models. A. Jafor *et al.* (2024) emphasised that the key driver of these changes is the transition to cloud technologies. Cloud solutions not only optimise internal infrastructure but also ensure high scalability and operational efficiency in resource management. Thus,

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cloud computing is becoming a basic structural element on which other digital solutions are built. In turn, the effectiveness of this infrastructure largely depends on the level of staff training. J. Stofkova *et al.* (2022) emphasised that the development of employees' digital skills stimulates innovation and increases companies' ability to adapt to market changes. Staff with new competencies interact much better with digital platforms, operate large data sets and can initiate process improvements. This means that human capital becomes not just a resource for servicing technical systems, but an active agent of digital transformation. M. Celestin *et al.* (2024) proved that personalised services and self-service platforms significantly increase customer loyalty. Analytical tools can be used to repurpose data on user behaviour to generate individualised offers and recommendations. This transforms customer interactions from transactional to long-term and value-oriented. Thus, digital services become a mechanism for forming a stable consumer base and increasing the value of the customer portfolio.

Digitalisation not only increases loyalty but also significantly improves the cost and operational model of the business. L. Xia *et al.* (2024) demonstrated that the introduction of digital tools provides simultaneous revenue growth and cost reduction through the automation of routine operations. Automated processes are faster and more accurate, which reduces errors and lightens the workload on staff. This is consistent with the research of M.V. Vasylykivskyi *et al.* (2024), emphasising that network automation and virtualisation can significantly reduce service time, optimise infrastructure capacity utilisation, and accelerate the deployment of new services. In other words, the structural capital of companies, including their networks, technologies, and architecture, becomes more productive and focused on rapid scalability. The range of digital solutions is expanding thanks to the Internet of Things (IoT), which, according to Z. Rehman *et al.* (2023), can be used to manage resources more efficiently and create smart services with a high level of accuracy and automation. IoT technologies generate large data flows that can be used to monitor infrastructure, predict loads and improve service quality. This helps companies not only optimise costs but also strengthen their competitive position by offering more innovative and adaptive services. Notably, the development of IoT and other digital technologies is impossible without a high level of digital competence among staff. Therefore, T. Ciarli *et al.* (2021) emphasised that training employees in digital and information technologies provides the basis for creating innovative solutions and strengthens human capital. New skills facilitate the faster implementation of digital initiatives, which accelerates the company's adaptation to technological trends and sharpens its innovative potential.

At the same time, according to H. Ji *et al.* (2022), the digitalisation of corporate processes significantly increases the adaptability of companies to dynamic changes in the external environment. The integration of digital platforms accelerates the analysis of existing trends, updates business

processes, and responds to market challenges. As a result, companies become more flexible, reduce decision-making time, and better maintain their competitive positions in conditions of high uncertainty. The formation of a sustainable business model largely depends on effective data management. F. Xiong *et al.* (2022) proved that competent data processing increases the value of a company's intangible assets. Analytical tools can be used by companies to predict customer behaviour, develop new approaches to customer service and improve service quality. As a result, customer capital becomes not only broader but also more valuable, as it is based on an accurate determination of user needs. A study by L. Melnyk *et al.* (2024) emphasised that digital transformation creates a synergy effect between human, structural and customer capital. The development of staff competencies ensures the effective use of technology; structural innovations form the infrastructure for flexible management; and improving the quality of customer interaction strengthens loyalty and long-term business stability. Thanks to the interaction of these components, companies not only increase productivity but also strengthen their strategic positions, making digitalisation a fundamental factor in their competitiveness.

The results of these studies have shown that digital transformations significantly increase the effectiveness of various components of telecommunications companies' intellectual capital and contribute to improving their productivity and economic performance. However, it remains insufficiently studied which specific digital strategies and practices ensure maximum synergy between human, structural and customer capital, which requires further research. The study aimed to investigate the impact of digital transformations on the development of the components of intellectual capital of telecommunications companies and their contribution to improving competitiveness and financial results. The study goals included: to examine the specific features of the impact of digital transformation on the human, structural and customer capital of companies, to assess the relationship between the development of intellectual capital and the performance of telecommunications operators, to analyse digitalisation practices using the example of leading telecommunications companies in Ukraine, such as Kyivstar, Vodafone Ukraine and Lifecell.

Materials and Methods

The study included a comprehensive analysis of the transformation of telecommunications companies' intellectual capital under the influence of digital technologies. To assess the digital transformation of telecommunications companies, data on the global growth in the number of Internet users worldwide from 2005 to 2025, provided by TVTechnology (2025), was used to analyse the impact of digital solutions on customer service efficiency and internal process optimisation. Human capital research was conducted by analysing the transformation of employees' professional skills in the areas of artificial intelligence (AI), cyber security, 5G networks, IoT and Big Data

(Alamuri *et al.*, 2025). The following methods were used to assess the effectiveness of staff development: studying corporate training programmes (internal and external training in digital technologies and cybersecurity), analysing retraining programmes aimed at mastering AI, Big Data and cloud platforms, and analysis of employee participation in practical technology projects and mentoring, which increases the innovative potential of personnel (Ewim *et al.*, 2021). The role of creativity and innovation capacity was assessed through an analysis of corporate practices for stimulating the generation of new ideas and non-standard solutions (Gui *et al.*, 2022). Methods of adapting human resource policies to global competition for talented specialists were also studied, in particular, the creation of attractive working conditions and human capital development programmes (Erkkilä *et al.*, 2023).

To determine the impact of structural capital on the development of telecom operators, data from Gitnux (Linder, 2025) was used to assess changes in network performance, company productivity, and financial results. Operational activities were studied by analysing the integration of automated resource management platforms and evaluating the use of analytical platforms and AI solutions to forecast demand for services and optimise network load. Digital ecosystem implementation practices were assessed through the analysis of the integration of IoT, Smart City, and Industry 4.0 services, which provide centralised data management and interaction between digital products. Data security methods were examined by analysing multi-level cyber protection systems, network monitoring and backup to support the reliability of the information infrastructure and the stability of business processes.

To assess the role of structural and customer capital, statistical analysis of the WifiTalents Team (2025) data was used, which showed the share of telecom companies that have implemented or strengthened digital transformation initiatives, invested in data analytics, integrated IoT platforms, and automated operational processes. Service personalisation methods included analysis of machine learning algorithms and intelligent customer interaction systems, which can be used to predict the needs of different user categories and forming individual offers. Approaches to integrating digital self-service platforms, mobile applications, and online chats that provide customers with round-the-clock access to services were also evaluated. To improve service quality, methods for monitoring service quality, ensuring network connection stability, and automated user support systems were studied. Lastly, to assess

the effectiveness of partner ecosystems, an analysis was conducted of the integration of IoT solutions, digital platforms, and third-party services, which enables comprehensive B2B and B2C customer service and increases the value of customer capital.

For practical analysis, the study covered the activities of Ukrainian telecom operators Kyivstar, Vodafone Ukraine, and Lifecell. These companies were selected for practical analysis due to their leading position in the Ukrainian market, active implementation of digital technologies, and diverse experience in transforming intellectual capital. Their implementation of IoT solutions, cloud services, digital customer engagement platforms, AI, and cybersecurity systems was studied. This was used to illustrate the real mechanisms of digital transformation and assess their impact on the development of human, structural, and customer capital.

The study included an analysis of the benefits of digitalisation, such as accelerating technological innovation, developing new services for corporate clients (B2B) and end consumers (B2C), strengthening cyber security, optimising costs and increasing revenues. It also examined the challenges of digital transformation, including the shortage of highly skilled professionals, the need for significant capital investment, the growth of cybersecurity risks, and the need to change corporate culture. Studying these aspects provided a comprehensive overview of digital transformation processes and laid the groundwork for further analysis of the economic and strategic impact on telecommunications companies.

Results

The number of Internet users worldwide is constantly growing, reflecting the gradual global digitisation of the population and the increasing integration of digital technologies into everyday life. The increase in the number of users reflects not only the expansion of access to the network, but also changes in the ways people communicate, work, learn and do business. This growth contributes to the development of e-commerce, digital services and online platforms, stimulates innovation in information technology and increases the importance of the internet as a tool for sharing information and providing services. At the same time, the proportion of the population using the internet is growing, indicating the gradual inclusion of different regions of the world in the global digital economy and the creation of conditions for greater integration of information resources into social and economic processes (Table 1).

Table 1. Number of Internet users worldwide (2005-2025)

Year	Number of users (billion)	Population percentage (%)
2005	~1	~15%
2006	~1.1	~17%
2007	~1.2	~18%
2008	~1.4	~20%
2009	~1.7	~23%
2010	~2	~27%

Continued Table 1

Year	Number of users (billion)	Population percentage (%)
2011	~2.1	~29%
2012	~2.3	~31%
2013	~2.5	~34%
2014	~2.7	~37%
2015	~3	~40%
2016	~3.3	~44%
2017	~3.5	~47%
2018	~3.8	~50%
2019	~4.2	~54%
2020	~4.7	~58%
2021	~5	~61%
2022	~5.3	~64%
2023	~5.5	~67%
2024	~5.8	~69%
2025	~6	~72%

Source: compiled by the author based on TVTechnology (2025)

Between 2005 and 2025, there was steady and significant growth in the number of Internet users worldwide, indicating a gradual global digitalisation of the population. In 2005, the number of users was approximately one billion, corresponding to approximately 15% of the world's population, while by 2015 this figure had grown to three billion, or approximately 40%. The trend continued in the following years: by 2020, the number of users exceeded 4.7 billion, covering 58% of the population, and by 2025, the number of users is expected to reach six billion, accounting for about 72% of the world's population. This dynamic demonstrates not only the expansion of internet access, but also the increasing role of digital technologies in everyday life and economic activity, stimulating the development of online services, e-commerce and digital infrastructure around the world.

Technologies require new competencies in cybersecurity, big data processing, cloud technologies, AI management, and 5G and 6G network operation. Presence of such skills not only maintains existing systems among staff but can also be used to create new services, improve operational efficiency, and provide additional value to the enterprise. Employees become active participants in digital transformations, and their competence forms the basis for the company's competitive advantages in the telecommunications market (Alamuri *et al.*, 2025).

To adapt to digital changes, companies actively encourage continuous learning and retraining of staff. This includes corporate training, participation in internal and external educational programmes, practical projects, and mentoring. This approach can be used by employees to master new technologies, including AI, blockchain, and automation, as well as develop key professional skills: digital literacy, data analytics, cybersecurity, and adaptability to new technologies. In addition, soft skills such as creativity, problem-solving and emotional intelligence are becoming increasingly relevant as people collaborate with AI systems. Continuous learning creates the conditions for a

flexible and motivated workforce that can respond quickly to changes in technology and the market, increasing productivity and reducing the risk of the company falling behind its competitors. Successful strategies include partnerships with educational institutions, internal training programmes, and the integration of flexible work cultures, which ensure the effective transformation of work functions and prepare staff for the future digital environment (Ewim *et al.*, 2021).

Employees who can generate new ideas and find unconventional solutions become key assets of the company. The development of innovative thinking contributes not only to improving the quality of products and services, but also to strengthening intangible assets such as patents, copyrighted developments and intellectual systems, which directly increases the productivity of individual companies and the efficiency of the division of labour between them. The study established that companies that invest heavily in intangible assets, especially young and small ones, benefit significantly from easier financing, particularly through bank loans, shareholder financing and government support. This creates favourable conditions for the rapid launch of new technological solutions and support for the company's innovation strategy in the market, as well as partially offsetting the financial barriers that hinder the development of innovative enterprises (Gui *et al.*, 2022).

Competition for talented specialists in the global labour market is forcing companies to adapt their HR policies. Companies strive to provide their employees with attractive working conditions: opportunities for professional development, participation in strategic projects, the use of advanced technologies, flexible schedules and remote work. This focus on personnel helps to increase employee loyalty, reduce staff turnover and build stable human capital capable of supporting and accelerating digital transformation processes. According to international rankings such as the Global Competitiveness Index, Global Innovation Index,

Global Talent Competitiveness Index, and Global Power City Index, countries and cities with high competitiveness and innovation scores demonstrate a greater ability to attract and retain talented professionals, underscoring the strategic importance of effective human capital management for companies (Erkkilä *et al.*, 2023).

Thus, digital transformations are changing human capital in telecommunications companies, making it a central factor in development and innovation. Investments in skills

upgrading, creativity development and adaptation to new technologies are becoming strategic for achieving competitive advantages. Highly skilled and innovative staff form the basis for companies' economic growth and ensure their sustainability in a rapidly changing digital environment. Digital transformations have significantly influenced the development of structural capital, which encompasses digital infrastructure, information systems, corporate standards, databases, and internal business processes (Table 2).

Table 2. The effects of digitalisation on operational efficiency and structural capital

Metric/change	Value/percentage
Percentage of telecoms companies that consider digital transformation critical to growth	85%
Percentage of operators reporting increased network performance or efficiency after DT	70%
Reducing operating costs through digital initiatives	-1520%
Growth in revenue per user (ARPU/revenue per subscriber)	+12%
Percentage of operators who used Big Data/analytics for personalisation or forecasting	7480%

Note: DT – digital transformation; ARPU – average revenue per user

Source: compiled by the author based on J. Linder (2025)

The data shows specific economic benefits of digitalisation for telecom operators. For example, a 12% increase in ARPU and a 70% increase in network efficiency among operators demonstrate the direct impact of digital technologies on revenue and productivity. The simultaneous reduction of operating costs by 15-20% and the widespread adoption of Big Data and analytics (74-80% of operators) underscore the strengthening of structural capital through process optimisation, the use of cloud platforms and network virtualisation, which can be used for rapid service scaling and the implementation of new business models.

Automation of internal processes has reduced the time required to perform routine operations, improved data accuracy, and reduced management costs. The use of cloud platforms has enabled centralised storage and processing of information, as well as simplified service scaling; 58% of smart city projects use cloud platforms, and edge computing is used in 35% of cases for local data processing. Big Data analytics has made it possible to evaluate process efficiency in real time, predict network load, and make informed management decisions; AI technologies have been implemented in 26% of projects to optimise traffic, energy consumption, and maintenance. In addition, digital innovations such as personalisation, self-service and behavioural pricing have significantly impacted the customer experience: the use of self-service platforms has increased customers' sense of influence and control, and IoT solutions for energy and waste management have been implemented in more than 45% of cities. As a result, telecommunications companies have been able to improve productivity, adaptability and resource management quality, while balancing the efficiency of digitalisation with the preservation of human contact to maintain long-term customer trust (Industry Research, 2025).

The introduction of new products and business models has become a key factor in strengthening structural capital. The growth of population density in cities and the

need to improve the quality of urban services have stimulated the widespread adoption of digital technologies: in the last decade alone, the number of digital devices such as sensors, actuators, smartphones and smart appliances has grown significantly, creating the basis for the development of the IoT. This foundation has shaped the concept of Smart City, which uses information and communication technologies to improve the efficiency of urban operations and the quality of interaction with the population. IoT services, Smart City solutions and Industry 4.0 approaches have made it possible to integrate various digital services into a single ecosystem, providing companies with new sources of revenue and promoting the development of innovative areas of activity. New business models involve the use of data as a strategic resource, enabling the creation of personalised products and strengthening interaction with customers and partners, while the expansion of digital capabilities supports long-term development and competitiveness. The development of digital infrastructure has become one of the central elements of structural capital. The deployment of 5G networks, the introduction of virtualised Software-Defined Networking (SDN) and Network Function Virtualisation (NFV), as well as edge computing, have significantly increased data processing speed and service scalability. Such technologies enable high data transfer speeds comparable to LTE (up to 300 Mbit/s for reception and 75 Mbit/s for transmission), ensure low latency, and improve the integration of IoT devices into smart city infrastructures compared to Wi-Fi, Bluetooth, Zigbee and Z-wave (Nassereddine & Khang, 2024).

Research into the implementation of integrated SDN-NFV architecture showed that upgrading the network infrastructure, in particular replacing standard virtual switches with DPDK and SR-IOV-based solutions, increased throughput to 200 Mbit/s at the server level and up to 1.6 Gbit/s at the edge nodes, while reducing latency to 12 ms and 17 ms, respectively. In addition, optimised

network management reduced operation execution time by 9-22 minutes, depending on the scenario (Surantha & Putra, 2022). This increase in performance has enabled companies to launch new products faster, improve service availability for corporate and private users, and manage network resources efficiently. Digital infrastructure has become the foundation for the development of new technologies, including automated control systems, AI solutions, and analytics platforms.

Fifth-generation technologies, together with IoT, create substantial infrastructure capable of connecting billions of devices with high speed, reliability and availability. At the same time, the integration of 5G-IoT has not yet been sufficiently studied in terms of security and management, which leads to a lack of practical solutions. The use of these technologies increases the efficiency, flexibility, scalability and simplicity of data analysis, but at the same time requires a number of issues to be addressed, including architecture design, coordination of interaction between devices, and ensuring confidentiality and cybersecurity. One promising approach is to ensure the compatibility of

all operating systems and implement open standards for seamless data exchange, which improves security through intelligent identification and authorisation mechanisms. Such solutions guarantee users a constant and secure connection, improving the user experience, while the implementation of the full potential of 5G requires an in-depth study of technical challenges and coordination of efforts at the industry level (Ahmed *et al.*, 2024).

Thus, digital transformations have turned structural capital into an integrated system of technologies, processes, and standards that ensures management efficiency, business scaling, and innovation development. Investments in automation, cloud platforms such as Amazon Web Services, Microsoft Azure and Google Cloud Platform, infrastructure development and cyber security enable companies to increase productivity, create additional economic value and strengthen their competitive position in the telecommunications market. Digital transformations have changed telecommunications companies' approach to customer capital management, defining the value of interactions with subscribers and corporate customers (Table 3).

Table 3. The impact of digital initiatives on customer capital and subscriber engagement

Metric/change	Value/percentage or trend
Percentage of telecoms companies that have stepped up their digital transformation initiatives since 2020	75%
Improved operational efficiency in companies that have implemented DT	+30%
Percentage of operators that increased investment in data analytics	70%
Percentage of operators that have integrated IoT platforms into their digital infrastructure	60%
Percentage of companies that see DT as key to future development of 6G/new networks	more than 80%

Source: compiled by the author based on the WifiTalents Team (2025)

The data shows how digital initiatives increase the value of customer capital by expanding opportunities for interaction with subscribers through mobile applications, IoT platforms, and personalised services. The high proportion of companies that perceive digital transformation as key to the development of 5G, 6G, and new networks indicates strategic planning and a focus on long-term customer loyalty. The results emphasise the significance of combining technological solutions and engagement strategies to enhance the effectiveness of B2B and B2C services and strengthen competitive positions in the market.

The transition to customer-oriented digital platforms, self-service services, and mobile applications has enabled companies to provide more convenient, faster, and more accessible services to various categories of users. Customers gained the ability to independently manage services, connect new tariffs and services, pay bills, and receive online support without having to visit offices in person. The introduction of cloud computing into digital platforms has made it possible to efficiently manage large amounts of data in real time, increase the speed of information processing, and improve the accuracy of consumer and operational data analysis. The use of parallel data processing models such as Hadoop, Spark, and Storm has ensured the flexibility and scalability of systems, ensuring

quick response to changes in demand and load. The integration of cloud solutions has significantly improved the performance of digital services and the stability of platforms, providing users with more timely and reliable access to services (Al-Jumaili *et al.*, 2023). Personalisation of services has become a key element in strengthening customer capital. The use of Big Data analytics, intelligent customer interaction systems, and machine learning algorithms has made it possible to offer users personalised services, optimise communication, and predict customer needs. These approaches have contributed to an increase in average revenue per user, greater loyalty, and a reduced risk of subscriber churn. Companies were able to plan marketing campaigns more effectively, create targeted offers, and form deeper relationships with customers, which contributed to an increase in long-term customer value (Talebkhah *et al.*, 2023).

Network technologies such as IoT, SDN, NFV, Docker containers, cloud computing, edge computing, and AI-based networking enable companies to efficiently collect, process, and analyse large amounts of data in real time. The implementation of deterministic and time-sensitive network solutions and advanced 5G/6G mobile technologies provides high data transfer speeds of up to 10 Gbit/s and low latency, less than 1 millisecond, which is critical

for services with high-quality service requirements, such as industrial automation systems, autonomous vehicles, and augmented reality applications. These innovations enable the creation of personalised, scalable and integrated digital services, improving service efficiency and user satisfaction (Beshley *et al.*, 2023). The development of partner ecosystems has become a substantial factor in supporting customers in both the B2B and B2C segments. The integration of IoT solutions, digital platforms, and partner services has enabled companies to offer comprehensive products and services covering various aspects of digital interaction. For business customers, this resulted in increased operational efficiency, process automation, and rapid technology integration, while private users gained access to innovative services and personalised digital solutions. This approach expanded the range of services offered by companies, increased the economic value of customer capital, and helped

strengthen long-term partnerships (Saeed *et al.*, 2023). Thus, the introduction of customer-centric digital platforms, self-service and mobile applications, the use of cloud computing, Big Data analytics, intelligent systems and advanced network technologies (IoT, SDN, NFV, Edge Computing, 5G/6G) has enabled telecommunications companies to provide fast and personalised service, optimise real-time data processing, predict user needs and create targeted offers.

Digital transformation is a key factor in the development of telecommunications companies in Ukraine, strengthening various components of intellectual capital: human, structural and customer. The country's leading operators are actively integrating digital technologies into their business processes, which contributes to increased efficiency, expanded services, and strengthened competitive positions in the market (Table 4).

Table 4. Comparison of digital transformation practices of leading telecommunications companies in Ukraine and their impact on capital and financial results

Company	Key DT priority	Impact on human capital	Impact on structural capital	Impact on client capital	Key financial/operational result
Kyivstar	AI, Smart services, My Kyivstar, cybersecurity, digital infrastructure development	The development of skills in working with AI and analytical platforms, improving staff efficiency	Optimisation of request processing, integration of digital platforms	Expanded digital services, improved network resilience Broadened access to essential connectivity, enhanced service reliability Growth in the share of digital sales and improved quality of experience	Digital revenue in 2025 increased 4.7 times to USD 124 million (a 4.9-fold increase to UAH 5.2 billion) and reached 10.7% of total revenue. In the fourth quarter of 2025, revenue from digital services grew 6.1 times to USD 50 million (a 6.4-fold increase to UAH 2.1 billion) and accounted for 15.7% of total revenue. The share of multiplay users rose 18.0% year on year to 7.3 million, representing 35.0% of active monthly mobile subscribers
Vodafone Ukraine	IoT, cloud services, Big Data	Improved staff skills in cloud technologies and analytics	Optimisation of internal processes, scaling of the network and digital products	Improved accessibility and speed of service, enhanced service quality	Investments in network and digital systems >6 billion UAH; increased network performance and stability
Lifecell	eSIM, digital identification, service automation	Improved staff skills, rapid adaptation to new technologies	Optimisation of internal processes, reduction of customer service time	Growth in the share of digital sales, increased availability and speed of digital services	increase in internet speedservice continuity and increased network performance

Source: compiled by the author

Kyivstar (2026b) actively uses AI, Smart services, the My Kyivstar platform, and cybersecurity services, which are used to personalise services, automate request processing, and improve service quality. These initiatives have contributed to ARPU growth, an increase in the share of multi-service subscribers, and a reduction in customer churn, with digital revenue in 2025 increased 4.7 times, reaching USD 124 million strengthening the company's customer and structural capital.

Vodafone Ukraine is focusing its digital transformation on IoT, cloud services, and Big Data analytics, which improves the efficiency of working with corporate customers. Significant investments in technological infrastructure

(UAH 6.215 billion in 2024) and network modernisation have made it possible to increase the speed and reliability of data processing, restore more than 1,000 base stations and deploy 7,252 LTE stations, strengthening structural capital, enabling service scaling and supporting the launch of new digital products (Kabachinsky, 2026).

In the fourth quarter of 2025, Kyivstar showed revenue growth of 28.4% to USD 321 million (by 30.1% YoY to UAH 13.5 billion), reflecting the consistent implementation of the converged services and digital transformation strategy. Mobile ARPU increased by 18.2% YoY to USD 3.8, and the share of users who switched to 4G tariffs increased by another 5.9 pp. Revenue from digital services

increased by 6.1 times YoY to USD 50 million (6.4 times to UAH 2.1 billion), reaching 15.7% of total revenue, of which Uklon's contribution amounted to USD 34 million (UAH 1.4 billion). The number of multiplayer users – those who simultaneously use voice services, 4G Internet and at least one digital application – increased by 18.0% YoY to 7.3 million, which is 35.0% of active mobile subscribers for the month. The expansion of Kyivstar's portfolio of services is increasingly integrating the company into the daily life of customers.

EBITDA increased by 21.7% to USD 172 million (by 23.1% to UAH 7.2 billion) in the fourth quarter of 2025, driven by revenue growth and disciplined cost control. EBITDA margin decreased by 2.9 pp YoY to 53.5%, which is in line with Kyivstar's previously announced targets, while the intensity of capital investments increased to 36% of revenue against the backdrop of seasonal factors and investments in network and energy sustainability.

The Kyivstar (2026c) expanded its digital healthcare services by acquiring Tabletki.ua in February – Ukraine's leading online marketplace for medicines and health products – for USD 160 million. Kyivstar (2026a) has extended Starlink Direct to Cell services to all its 4G users, and nearly 5 million subscribers have already used the basic text-messaging capabilities. The launch of voice services and low-bandwidth data transmission is planned for later in 2026.

In December, the Kyivstar (2025) acquired LLC “SANVIN 11”, the owner of a 12.9 MW solar power plant. This investment enables Kyivstar to diversify its energy sources and reduce risks related to energy supply. In February 2026, Kyivstar also announced the acquisition of the internet provider “Shtorm”, expanding the Group's share in the highly fragmented fixed broadband market.

Lifecell (n.d.) is implementing eSIM, service automation and digital identification, which reduces service time and increases the share of digital sales. Digital initiatives contribute to the development of staff competencies and increase the productivity of internal processes. Thanks to 4G modernisation and a stable network infrastructure the average mobile internet speed has increased by 20-30%, which improves the company's flexibility, efficiency and competitive position.

Thus, the digital transformation of Ukraine's three leading mobile operators demonstrates the systematic strengthening of their customer, structural and human capital through the large-scale implementation of innovative technologies. The development of AI solutions, cloud platforms, smart services, IoT infrastructure, eSIM and digital identification ensures revenue growth, increased productivity of internal processes, expansion of multi-service capabilities and improved quality of subscriber service. Significant investments in network modernisation, management automation and infrastructure resilience enable operators to maintain a high level of technological readiness, ensure communication stability even in crisis conditions and maintain service continuity. As a result,

digital initiatives create a sustainable competitive advantage in the market, contribute to the financial growth of companies, and lay the foundation for further innovation in Ukraine's telecom sector.

As of early 2025, approximately 31.5 million people in Ukraine used the internet, and the network penetration rate reached approximately 82.4%, indicating a high level of digitalisation among the population and active use of digital services, including telecommunications services. 94.1% of mobile connections in Ukraine were broadband (3G/4G/5G), which is a relevant component of the digital transformation of the telecom industry (Zinchenko, 2025). Digital transformations contribute to the acceleration of technological development. Cloud platforms, Big Data analytics, AI, and 5G/6G networks are used by telecom operators to quickly adapt to changes in the tech environment, introduce new services, and make internal processes more efficient. Thanks to AI technologies such as machine learning and deep learning, systems can automate, analyse data, gain predictive insights and adapt to new conditions.

The number of connected wireless devices worldwide has grown from 11.5 billion in 2020 to 31.6 billion in 2023, illustrating the scale of traffic growth and the need for network automation. AI enables the next generation of wireless networks to automatically exchange information between “smart” applications, significantly improving network performance. 5G networks provide high data transfer speeds and low end-to-end latency, while URLLC services guarantee latency of less than 1 ms, which is critical for controlling smart devices, remote medicine, and industrial robots. This approach reduces time to market, increases responsiveness to customer needs, and strengthens the company's position among competitors (Alhammadi *et al.*, 2024).

The increase in the value of intangible assets is a significant outcome of digital transformation. Data, software solutions, digital platforms, intelligent management systems, and patents are becoming strategic resources that support business development. Strengthening intellectual property protection has a positive impact on the process of data capitalisation: an analysis of a long-term panel sample of Chinese companies for 2011-2022 showed that effective IP protection increases both the resources for data capitalisation and the willingness of companies to use them. The greatest effect is observed in private companies, high-tech industries, and regions with developed digital infrastructure. Thus, intangible assets form the basis for new business models and create additional economic value for the company, which directly affects its financial results and investment attractiveness (Wang & Dong, 2025).

Expanding the competencies and creative capabilities of staff contributes to increased productivity and human capital development. Employees acquire new skills in cybersecurity, big data processing, AI management, and digital networks, which increases their ability to generate innovative solutions. Research confirms that the systematic strengthening of human resource competencies, combined with the active use of technology and

diversification of activities, significantly increases the productivity of enterprises: for example, analysis of small and medium-sized businesses has shown that the combination of these factors has a positive and statistically significant impact on their sustainable operations, with a coefficient of determination of 72.3%. In addition, effective personnel development and support from public policy are fundamental in ensuring the stability and growth of enterprises. This ensures quick adaptation to change, efficient resource utilisation, and the maintenance of high intellectual value (Hernita *et al.*, 2021).

Digitalisation enables companies to optimise operating costs and improve key financial indicators. Studies show that companies that actively implement digital technologies can reduce operating costs by approximately 30%, increase ARPU by 20%, increase earnings before interest, taxes, depreciation and amortisation (EBITDA) by 25% and improve return on assets by 15% compared to less digitised companies, indicating significant economic benefits from the implementation of digital solutions (according to a business process optimisation model using AI and big data analytics) (Liao *et al.*, 2025). This confirms that process automation, analytics and cloud technology implementation directly impact the financial performance and economic sustainability of companies, contributing to increased productivity and reduced costs. These trends are reflected in studies on digital business transformation, which indicate the positive impact of digital solutions on the performance and competitiveness of enterprises. Thus, digital transformation comprehensively strengthens the intellectual capital of telecom companies, increasing business flexibility, service quality and financial results. The integration of AI, Big Data and cloud solutions contributes to the creation of new sources of value and the formation of effective business models. This strengthens the market position of operators and ensures stable long-term development.

In the process of digital transformation, telecommunications companies face several systemic constraints that slow down modernisation and affect the effectiveness of innovation implementation. Despite the active introduction of AI, big data, automation and cloud solutions, the industry needs more developed organisational, human resource and financial prerequisites. Therefore, the ability of companies to identify and remove internal and external barriers that hinder the formation of a sustainable digital ecosystem is becoming a key condition for successful transformation (Mahboub & Sadok, 2024). One of the main constraints is the shortage of highly qualified personnel. The effective implementation of technologies such as AI, Big Data analytics, cloud platforms and 5G/6G networks requires employees with specialised knowledge and experience. A study of digital literacy among higher education students (N = 324) showed that the level of training of future specialists is uneven: the lowest scores were in working with digital information, particularly in the ability to assess data quality and identify source bias. The highest results, on the other hand, were in social digital literacy, such as the skills

of proper online communication. Although the difference between the studies was insignificant, experience and length of study had a positive impact on the level of digital competence. These results indicate that the modern level of training does not fully meet market requirements, which creates competition for specialists and complicates the formation of strong human capital and the development of innovative projects (Morgan *et al.*, 2022).

The implementation of digital technologies requires significant financial resources. Investments in infrastructure development, the purchase of licensed software, and the implementation of cloud platforms and cybersecurity systems create high capital expenditures, which increase OPEX. Research on the digitalisation of small professional service firms shows that even organisations with limited resources recognise both the opportunities and risks of digital transformation, but the complexity of the technological environment and the instability of the innovation landscape often led to organisational tensions and inhibit decision-making. Such firms tend to adopt a “selective digitalisation” approach, where investments in technology are made selectively depending on the innovation orientation of management and staff. At the same time, expanding cooperation with technology providers and partners creates additional costs for coordination and network management. Therefore, telecommunications companies should carefully plan financial policies and ensure the efficient use of resources to benefit from the economic effects of digitalisation and avoid overspending (Cardinali *et al.*, 2023).

Increased cyber risks are another significant challenge. The expansion of digital platforms, growth in data volumes and integration of IoT solutions create additional vulnerabilities for cybersecurity. Research on sustainable digitalisation emphasises that cyber threats can undermine environmental, social and economic sustainability, as privacy breaches, data leaks or digital system failures can have significant socio-economic consequences. Therefore, cybersecurity must be considered an integral part of sustainable digitalisation, requiring flexible policies and regulations that can adapt to the rapid changes in the digital environment. Experts also emphasise the importance of a multi-stakeholder approach involving the state, business and users for effective risk management. The implementation of comprehensive data protection systems, network monitoring and backup procedures is critical to minimising the risks of information loss, financial loss or reputational damage (Goswami *et al.*, 2023).

Equally relevant is the transformation of corporate culture and the adaptation of business processes. The introduction of new technologies requires a change in management approaches, greater openness to innovation, flexibility, and the ability to make quick decisions. Research based on the theory of innovation adoption and a systematic review of the literature for 2011-2024 shows that organisational culture is a key factor in the successful implementation of Business Process Management. Companies with a culture focused on innovation, collaboration and continuous

improvement have a significantly higher level of acceptance of Business Process Management, while barriers such as resistance to change and risk aversion significantly reduce the effectiveness of digital transformations and employee satisfaction. This highlights the need to create an adaptive and innovative environment in which companies encourage staff training, implement cross-functional teams and change internal processes to effectively integrate digital tools (Lima *et al.*, 2025).

Thus, overcoming personnel, financial, cybersecurity, and cultural barriers is a fundamental condition for the successful digital evolution of telecom companies. By building strong human capital, ensuring cyber security, optimising investments and creating an innovation-oriented corporate culture, companies can significantly improve the efficiency of their business processes. This not only minimises risks but also ensures strategic stability, rapid scaling of digital services and long-term growth in competitiveness in the context of dynamic market changes.

Discussion

The analysis of the results showed that digital transformations had a significant impact on the development of human capital in telecommunications companies. The introduction of continuous learning programmes and internal training ensured quick adaptation of staff to new technologies, increasing creativity and innovative potential, which was reflected in productivity and the ability to create added value for the company. This issue was also studied by P. Ueasangkomsate & T. Soodsom (2024), confirming that telecom companies need employees who possess relevant digital skills and can utilise innovative technologies. Developing such competencies contributes to increased productivity, efficiency, and business competitiveness. Investments in human capital ensure the sustainable growth of companies and their ability to quickly adapt to technological changes. A. Arini & H. Respatiningsih (2024) also showed that the digital economy requires constant updating of knowledge and professional skills. Training and retraining help staff respond effectively to new challenges and master new tools. Supporting innovation within the team stimulates a creative approach to work and contributes to the formation of the company's competitive advantages. Analysis of the results shows that effective development of digital competencies requires a systematic approach that includes both technical training and the development of analytical thinking and communication skills. Telecom companies must provide access to learning platforms, practical training, and opportunities for professional growth. In addition, it is necessary to create a corporate culture prioritising innovation and continuous learning, which will ensure a smooth transition for employees adapting to rapid technological changes.

The study showed that structural capital also underwent significant changes under the influence of digitalisation. The study determined that process automation, cloud management systems and the use of big data

analytics increase the efficiency of internal operations. In addition, the introduction of IoT services, Smart City and Industry 4.0 solutions created new sources of revenue and contributed to the development of innovative products. The expansion of digital infrastructure, including 5G, virtualised networks and edge computing, increased the scalability of services and the speed of launching new services. L. Broccardo *et al.* (2024) concluded that business process automation enables telecom companies to reduce costs, accelerate customer service, and improve service quality. The development of high-speed networks and the introduction of cloud platforms form the basis for scaling digital services and creating new products. Such modernisation strengthens the structural capital of enterprises and ensures stable development in the context of technological competition. A study by V. Stocker & G. Knieps (2021) determined that the expansion of digital infrastructure requires the transformation of organisational management models and the introduction of more flexible approaches to planning. Telecom companies are actively integrating innovative solutions such as AI and IoT technologies to optimise their operations. These changes contribute to the formation of telecommunications ecosystems capable of responding quickly to market and customer needs. These results confirm the above study, as they demonstrate a close link between the digital transformation of structural capital and the growth in efficiency of telecommunications companies. The introduction of automated systems and the latest technological solutions ensures the optimisation of internal processes and improved service quality. Thus, the modernisation of digital infrastructure is becoming a key factor in strengthening companies' competitive positions in the market.

Digital transformations were found to have a significant impact on customer capital. Companies implemented customer-centric digital platforms and self-service services, which increased the accessibility of services and simplified subscriber interaction with the company. Personalisation of services through big data analysis and IoT integration made it possible to predict user needs and increase ARPU, which strengthened customer loyalty and reduced churn. It is worth highlighting the study by J. Oumaima & S. Lamari (2024), demonstrating that personalisation of services improves awareness of the needs of their users and offer solutions that best meet their expectations. Digital platforms provide more convenient communication and self-service channels, which increase subscriber satisfaction. High-quality interaction with customers helps build trust in the company and strengthen its reputation in the market. In turn, M. Pereira *et al.* (2025) concluded that the use of digital tools not only expands the capabilities of the service but also creates an individual experience for each user. Analytics systems help predict customer behaviour and respond to their requests in a timely manner. As a result, higher loyalty and long-term customer capital value are formed, which has a positive impact on the financial performance of telecom companies. These data

correspond to the theses presented in the previous section, as they confirm the importance of digital tools for increasing subscriber satisfaction and engagement. Thanks to personalised services and convenient platforms, companies can form stronger and longer-lasting relationships with their customers. This, in turn, ensures sustainable growth in customer capital and strengthens the competitive advantages of telecom operators.

In addition, the study demonstrated the benefits of digital transformation for intellectual capital. The study determined that innovative approaches contributed to the growth of companies' intangible assets, increased staff competence and improved financial performance. Companies that effectively integrated digital technologies into all aspects of their operations achieved better adaptability to technological changes and gained competitive advantages in the market. Notably, R. Trequattrini *et al.* (2022) conducted a study, the results of which confirmed that digital transformation stimulates the development of innovative products and services, ensuring a quick response to market changes. It increases the adaptability of organisations by ensuring the rapid introduction of new technologies and processes. In addition, investments in digital solutions strengthen the intangible assets of enterprises, in particular their brand, reputation and staff knowledge. H. Halim *et al.* (2023) showed that a digital transformation strategy aimed at optimising the company's performance can be used for the improvement of operational processes and increased productivity. The use of data analytics, automation, and digital platforms contributes to more informed management decisions. This ensures increased competitiveness and sustainable long-term development of the company. Comparing the data obtained during the research, it is possible to argue that digital transformation directly affects the growth of the innovative potential and flexibility of telecom companies. It contributes to the accumulation of intangible assets, such as staff knowledge, brand and technological expertise, which increases the overall value of the enterprise. Therefore, investments in digital solutions are strategically relevant for strengthening the company's position in the dynamic communications market.

At the same time, the study revealed significant challenges faced by telecommunications companies. The main problems were a shortage of highly qualified personnel, high investment and operating costs, and increased cyber risks. In addition, companies were forced to transform their corporate culture to more effectively implement innovative processes and ensure organisational flexibility. Based on the results of the study, K. Uzule & N. Verina (2023) concluded that the digital transition of telecom companies faces staffing challenges related to a shortage of specialists capable of working with the latest technologies. Financial constraints can delay the implementation of digital platforms and network modernisation, limiting the scale of transformation. In addition, technological and security risks, including cyber threats and the complexity of integrating new systems, create additional barriers to an

effective transition to digital models. Data from Y. Niu *et al.* (2023) show that the implementation of innovative technologies is often hampered by organisational inertia and staff resistance to change. A lack of financial resources and difficulties in integrating new systems can significantly slow down the pace of digital transformation. As a result, companies risk losing ground to competitors and missing opportunities to create new services and improve business process efficiency. An analysis of the study results revealed that the main threats to digital transition significantly affect the speed and efficiency of telecom companies' transformation. Personnel and financial constraints, as well as technological challenges and security risks, require a systematic approach to planning and managing digital projects. Only a comprehensive strategy that addresses these factors can minimise negative consequences and ensure the successful integration of innovations into business operations.

Based on the data obtained, it is possible to conclude that digital transformations played a key role in strengthening the intellectual capital of telecommunications companies. They simultaneously influenced human, structural and customer capital, ensuring increased productivity, the development of new services and the economic stability of companies. The results of the study emphasise the need for a comprehensive approach to the integration of digital technologies to achieve strategic competitive advantages in the market.

Conclusions

The study showed that the digital transformation of telecommunications companies has a significant impact on the development of human, structural and customer capital, increasing productivity and competitiveness. As of 2025, the number of Internet users worldwide reached ~6 billion people, or 72% of the population, and in Ukraine, about 31.5 million people used the Internet, which is 82.4% of the population. The growth in the number of users is accompanied by an increase in staff competence in the areas of AI, big data analytics, cybersecurity and 5G/6G networks, which is a key factor in successful digitalisation. The structural capital of companies has been strengthened through process automation, cloud platforms and analytical solutions: routine operations have been reduced by 30-40%, and 85% of operators consider digitalisation critical to development. 70% of companies report increased network productivity, and cost optimisation was 15-20%. The use of Big Data and IoT platforms has improved the accuracy of forecasts and the efficiency of resource management.

Customer capital was transformed through service personalisation, self-service platforms, and IoT ecosystem integration. Kyivstar revenue in Q4 2025 increased 28.4% to USD 321 million; mobile ARPU rose 18.2% year-on-year; digitalservices revenue grew 6.1× to USD 50 million (15.7% of total, including USD 34 million from Uklon); multiplay users increased 18% to 7.3 million; EBITDA rose 21.7% to USD 172 million with a 53.5% margin; capex

intensity reached 36% of revenue. Vodafone invested over UAH 6 billion, deploying 7,252 LTE stations, which improved network stability, while Lifecell increased internet speeds by 20-30%.

The results of the study confirmed the key benefits of digital transformation: increased innovation and creative potential of staff, accelerated adaptation to technological changes, growth in the value of intangible assets, process optimisation and improved economic efficiency. At the same time, the main challenges were identified, high investment costs, increased cyber risks, and the need to change corporate culture for rapid innovation implementation.

Thus, digital transformations have become a catalyst for strengthening the intellectual capital of telecommunications companies, creating conditions for sustainable development, increasing competitiveness, and achieving strategic advantages in the market. The limitation of the

study is that the analysis was based on open data and reports from individual Ukrainian telecom operators, which may not fully reflect the situation in the global market. Prospects for further research include a detailed study of the impact of digital transformations on the long-term sustainability of intellectual capital and its relationship with the financial and non-financial performance indicators of telecommunications companies.

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Conflict of Interest

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Роль цифрової трансформації у формуванні та розвитку інтелектуального капіталу телекомунікаційних підприємств

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Анотація. За мету ставилося визначення того, як впровадження цифрових технологій змінює складові інтелектуального капіталу телекомунікаційних компаній та впливає на їхню ефективність і економічні результати. Для дослідження цифрової трансформації телекомунікаційних компаній використовувалися методи аналізу даних, інтеграції аналітичних та платформ штучного інтелекту, оцінки впливу Інтернету речей, хмарних сервісів та цифрових екосистем на ефективність бізнес-процесів, персоналізацію сервісів та розвиток інтелектуального капіталу. Було встановлено, що у 2025 році кількість інтернет-користувачів у світі досягла близько 6 мільярдів осіб (72 % населення), тоді як в Україні цей показник становив 31,5 мільйона осіб (82,4 % населення). Визначено, що структурний капітал телеком-операторів посилювався завдяки автоматизації процесів, впровадженню хмарних платформ та аналітики даних; 85 % операторів вважають цифровізацію критичною для зростання, 70 % повідомили про підвищення продуктивності мереж, а операційні витрати знизилися на 15-20 %. Також встановлено, що клієнтський капітал трансформувалася завдяки персоналізації сервісів, платформам самообслуговування та інтеграції Інтернету речей. Було з'ясовано, що Kyivstar підвищила ефективність обслуговування, цифрова виручка у 2025 році зросла у 4,7 раза – до 124 млн дол США (у 4,9 раза – до 5,2 млрд грн) і досягла 10,7 % у структурі виручки. У четвертому кварталі 2025 року дохід від цифрових сервісів у 2025 році зріс у 6,1 раза – до 50 млн дол. США (у 6,4 раза – до 2,1 млрд грн) і склав 15,7 % від загальної виручки. Частка користувачів пакетних послуг (multiplay-користувачів) зросла на 18,0 % р/р – до 7,3 млн, що становить 35,0 % активних мобільних абонентів за місяць. Дослідження показало, що Vodafone інвестувала понад 6 мільярдів гривень у модернізацію мережі та розгорнула 7252 LTE станції. Було визначено, що Lifecell підвищила швидкість інтернету на 20-30 %. Ці зміни зміцнили людський, структурний та клієнтський капітал і підтримали інноваційний розвиток телеком-операторів. Практичне значення дослідження полягає у тому, що його результати можуть бути використані для розробки ефективних стратегій цифрової трансформації телекомунікаційних підприємств та підвищення ефективного управління їх інтелектуальним капіталом

Ключові слова: хмарні технології; автоматизація; інновації; персоналізація; продуктивність; лояльність абонентів