Denisova O.O., Candidate of Economic Sciences, Associate Professor, Doctoral Candidate, Kyiv National Economic University named after Vadym Hetman

DIGITAL TRANSFORMATION OF ENTERPRISE ARCHITECTURE

Enterprise architecture, defined as its fundamental organization or properties within its environment, along with the guiding principles for its implementation and evolution and the related lifecycle processes [1], is largely determined by the information systems and technologies employed. These information systems form a crucial part of the technological infrastructure and, along with other architectural elements, are designed to support the enterprise in achieving its short-term and long-term business objectives. Digital technologies and tools are integrated into various aspects of enterprise operations to enhance productivity, efficiency, and competitiveness [2]. Terms such as «digitization», «digitalization», and «digital transformation» (DT) [3] are used to describe the extent of these changes. «Digital transformation» refers to the profound changes in the business and operational models of the enterprise, creating new opportunities for generating added value. Enterprises across various sectors, such as automotive, energy, healthcare, banking, logistics, aviation, and tourism, are adopting new high-tech solutions to transform business practices and secure competitive advantages.

While digital transformation is increasingly capturing the attention of scholars, practitioners, governments, and ICT providers, most enterprises recognize its potential impact. However, many of these enterprises do not have a clear action plan to restructure existing processes to align with new technologies. Although 74 % of enterprises consider digital transformation a priority, only 35 % of these initiatives are successful [4], and, on average, 87.5 % of digital transformations fail to meet their initial goals [5]. The success of transformation efforts largely depends on addressing a comprehensive set of strategic and operational organizational, managerial, technical, and cultural challenges, as well as executing a sufficient number of actionable steps [6]. The primary challenges in implementing digital transformation include the complexity of planning, resistance to organizational changes, skill shortages, outdated infrastructure, lack of a clear strategy and vision, security and privacy issues, resource limitations, rapid changes in technology, trends, and expectations, and the difficulty in quantitatively assessing the effectiveness of relevant investments due to their intangible and hard-to-measure outcomes [7, 8]. Recent studies [9–11] indicate that using a structured and standardized model to delineate processes and development pathways for digital transformation can enhance the return on investment. Enterprise architecture models such as TOGAF, the Zachman framework, Gartner, FEAF, DoDAF, the NIST enterprise architecture model, and the ISO 19439 enterprise modeling standard, among others, can be utilized to reduce uncertainty and accelerate transformation. These models help achieve a comprehensive understanding of processes, support the development of a transformation roadmap, and ensure alignment with business objectives while managing challenges and risks [12].

Each enterprise architecture framework has its strengths and weaknesses, prompting many enterprises to adopt a hybrid approach. A viable alternative is the Unified Architecture Framework (UAF), an architectural model that offers a standardized and consistent methodology based on UML and SysML languages, the DoDAF Unified Architectural Framework Profile, and the UK Ministry of Defence Architectural Framework [13]. UAF is designed to support the modelling of a wide range of complex systems, which may include hardware, software, data, personnel, and infrastructure elements, as well as modelling for systems that incorporate other systems (system of systems, SoS). It provides methods for presenting enterprise architecture that enable stakeholders to concentrate on specific business processes, operational and business requirements, and the system integration of commercial and industrial enterprises.

The UAF comprises three main components: the Domain Metamodel (DMM), the UAF Profile (UAFP), and the UAF Grid. The standard facilitates the development of various model types: Taxonomy (Tx), Structure (Sr), Connectivity (Cn), Processes (Pr), States (St), Interaction Scenarios (Is), Information (If), Parameters (Pm), Constraints (Ct), Roadmap (Rm), Traceability (Tr), as well as Metadata. It also includes models for the Strategic, Operational, Services, Personnel, Resources, Security, Projects, Standards, Actual Resources, Dictionary, Summary and Overview, and Requirements domains. These models are employed to represent different elements and their interrelations within the enterprise architecture. For example, the taxonomy organizes all elements as an independent structure, whereas connectivity details the connections, relationships, and interactions among various elements. Specifically, the UAF Operational Domain depicts the enterprise’s logical architecture, including its requirements, operational behaviours, structures, and exchanges needed to support functionality. Meanwhile, the Resources

Domain outlines how resource configurations meet operational requirements and enhance overall functionality.

One of the advantages of UAF is its built-in integration with system modelling tools and support for Model-Based Systems Engineering (MBSE) [14, 15]. While UAF does not prescribe a specific graphical notation for modelling, it provides guidelines for utilizing various types of SysML diagrams to generate specialized views. Additionally, UAF addresses the absence of pragmatism and a standardized methodology in modelling languages for systems of systems [16]. The UAF framework aims to enhance the quality, productivity, and efficiency of modelling for enterprise architectures and systems of systems. It promotes the reuse of architectural models, supports their maintenance, and improves the compatibility of various modelling tools.

One of the limitations of UAF is its lack of a defined method for architectural development. This limitation can be addressed by leveraging the compatibility between UAF and TOGAF, whose metamodels serve as alternative options within the same class, and by implementing the TOGAF Architecture Development Method (ADM). Additionally, the incorporation of Model-Based Systems Engineering (MBSE) into enterprise architecture development significantly enhances the success of digital transformation (DT) [17]. Specifically, the model-based approach enhances requirement management practices by using models as the central element in change management, providing a foundation for collaboration and communication among all stakeholders, and facilitating the tracking of requirements throughout the design and implementation phases. SysML requirements diagrams, in particular, help organize and visualize all types of requirements and their interconnections, and establish links between requirements and project elements. However, neither the architectural framework nor the MBSE methodology inherently supports the processes of goal setting and requirements definition, whereas developing a clear and comprehensive digital strategy is crucial for successful DT.

A benchmark for evaluating the vision and business objectives pursued during DT, as well as the goals of specific digital initiatives, is the digital maturity level of the enterprise. This level reflects the enterprise's capability to create value using digital technologies and processes. To determine this, models and tools that are widely available on the market can be utilized. The characteristics of the most popular digital maturity models, developed by international consulting firms, are summarized in Table 1. Analysis of these models reveals a consensus among experts: digital transformation exceeds the mere implementation of individual technologies; it necessitates the creation of a complex of technologically interconnected assets and the expansion of business capabilities. The models typically include components such as technology, digital culture, digital skills, operations, and processes (Table 2). The digital maturity assessment framework under the European Commission's program «Digital Europe» introduces fundamentally new components [18]. According to this model, the digital maturity of enterprises, particularly small and medium-sized ones, as well as public sector organizations, should be measured across specific dimensions:

– digital strategy and investments – the overall status of the enterprise's digitalization strategy, its readiness to embrace digital changes that may require substantial organizational and economic efforts, and investments in digital initiatives across all operational areas;

– digital readiness – the current use of digital technologies, encompassing both foundational and advanced technologies;

– human-centric digitalization – the skills of the staff, their engagement with digital technologies, and the enhancement of employee capabilities that contribute to improved productivity and well-being;

– data management and security – the digital storage of data, its organization, accessibility, and use for business objectives, all while ensuring adequate data protection;

– green digitalization – the organization's ability to undertake long-term digital initiatives with a responsible approach to conserving and sustaining natural resources and the environment.

An additional dimension for public sector organizations under this framework is interoperability – the adherence to standards and shared technical specifications that enable various systems and services to interact with each other, following the European Interoperability Framework. For enterprises, the degree of automation and intelligence provided by digital tools integrated into business processes should also be evaluated.

Digital maturity models are used to evaluate the digital capabilities of enterprises, identify gaps, and prioritize digital initiatives for both short-term and long-term periods, as well as for benchmarking purposes. Given the ever-changing technological landscape and business environment, one of the most critical attributes for enterprises remains their agility – their ability to quickly and effectively respond to changes. In this context, there is a need for a generalized framework to structure the components of existing models. This framework would ensure flexibility and adaptability in measuring digital maturity, facilitate the comparison of different models and the assessment results derived from them, establish goals, and prioritize digital transformation efforts, all while maintaining a comprehensive approach to DT.

Table 1

CHARACTERISTICS OF DIGITAL MATURITY MODELS, DEVELOPED BY CONSULTING COMPANIES

Digital Maturity Model	Features	Key Components or Assessment Areas	Maturity Stages
Deloitte-TM Forum Digital Maturity Model	Offers a holistic view on digital transformation efforts	Customer, Strategy, Technology, Operations, Organization, and Culture	Early, Developing, Maturing
Gartner Digital Business Maturity Model	Pinpoints essential competencies for organizations to focus on for digital business success	Digital Strategy, Leadership, Culture, Capabilities, Ecosystem, Customer Experience, Innovation, Operations, and Management	Initial, Experimentation, Scaling, Transformation, Digital Leadership
Google and Boston Consulting Group Digital Maturity Model	Concentrates on the capabilities for digital marketing	Strategy, Process, Organization, Technology, Customer	Nascent, Emerging, Connected, Multi-Moment
Capgemini Digital Transformation Maturity Model	Categorizes organizations by their digital practices	Transformation Management Intensity, Digitization Intensity	Digital Beginner, Conservative, Fashionista, Digital Elite («Digirati»)
BCG Digital Acceleration Index (Boston Consulting Group)	Evaluates strengths and weaknesses of enterprises relative to competitors, digital leaders, and industry averages	Digital-based Strategy, Core Value Chain Digitization, Digital Growth Stimulation, Work Method Changes via Digital Technologies, Data and Technology Management, Future Readiness, Integrated Ecosystems	Digital Beginner, Knowledgeable, Performer, Leader
The Digital Maturity Model 5.0 (Forrester)	Assesses the systematic application of best digital practices	Culture, Organization, Technology, Insights	Sceptics, Adherents, Partners, Change Agents

Source: Compiled by the author based on [19–27]

Table 2

COMPONENTS OF ACADEMIC MODELS OF DIGITAL MATURITY

Rank by frequency of mention	**Key Components**	
	Models for a specific field of activity	**General-purpose models**
1	Technologies	Digital Culture
2	Digital Skills	Technologies
3	Operations and Processes	Operations and Processes
4	Products and Services	Digital Strategy
5	Compliance and Security	Organization
6	Digital Culture	Digital Skills
7	Digital Strategy	Innovations
8	Organization	Customer Understanding and Experience
9	Management	Management
10	Digital Ecosystem	Vision
11	Innovations	Digital Ecosystem
12	Customer Understanding and Experience	Leadership
13	Digital Business Model	Compliance and Security
14	Vision	Products and Services
15	Leadership	Digital Business Model

Source: Compiled by the author based on [28]

Deloitte's expert groups propose several alternative options for defining such a framework. The Deloitte Digital Maturity Index is structured into two sub-indices, which correspond to management and planning levels [29]. The first, a strategic index, encompasses aspects of digital business including parameters like the organization's network of connections, its value creation structure, investments in digitalization, and software services. It also takes into account dynamic capabilities related to managing the life cycle of a company's products, investments in new assets, technology monitoring, and adaptability. The second, an operational index, focuses on digital activities such as the enterprise's investments in smart devices and equipment, smart planning, connected client applications, and efficient logistics. It further includes digital capabilities that emerge from the integration of digital technologies into business processes, operations, and corporate culture, support from top management, clear roadmaps, and a focus on intelligent key performance indicators. Deloitte China's Risk Advisory group identifies three key pillars for evaluating an organization's digital maturity: digital strategy, technological processes, and agile organization [30]. Meanwhile, Deloitte Digital's Austrian team suggests a comprehensive approach to assessing the digital maturity of enterprises, incorporating several key aspects:

– dimensions – digital human resources, digital processes, digital technologies;

– focus areas – strategy and transformation, organization, distribution, marketing, customer service, digital products, data and reporting, front-end technology, back-end infrastructure;

– core processes – IT, HR, procurement, finance, and technical processes [31].

Each of the mentioned approaches is well-founded and emphasizes important areas for applying digital technologies, yet it is the architecture of the enterprise that enables their orderly integration. Based on the analysis of existing maturity models within the context of enterprise architecture levels, the following key digital technology aspects were identified: digital infrastructure, data management, and digital intelligence, the digitization of operations, as well as digital marketing and digital business. Each of these aspects requires investments and a holistic approach to decision-making, planning, and design. This involves engaging qualified professionals, training staff, implementing organizational and managerial changes, reengineering business processes, and developing a specific corporate culture. Particular attention should be paid to digital alignment.

Table 2

DIGITAL TRANSFORMATION ACROSS ENTERPRISE ARCHITECTURE LEVELS

<table>
<tr><th>Enterprise architecture levels</th><th colspan="2">Key aspects of digital transformation</th></tr>
<tr><td>Business Architecture</td><td>Digital business models, digital business</td><td rowspan="4">Digital development and alignment</td></tr>
<tr><td>Application Architecture</td><td>Digital operations, digital marketing</td></tr>
<tr><td>Information Architecture</td><td>Information asset management</td></tr>
<tr><td>Technology Architecture</td><td>Digital infrastructure</td></tr>
</table>

Source: Developed by the author

For many companies, digital transformation starts with modernizing their **IT infrastructure**. This process equips enterprises with the latest tools to enhance economic efficiency, accelerate operations, boost employee satisfaction, improve customer service, and reduce maintenance costs. Managing digital infrastructure involves deploying and administering technological components, systems, and services that support an enterprise's digital activities. The goals of rapidly and adaptably meeting business demands and providing necessary technological resources, such as computing power and data storage, are accomplished through the implementation of on-demand services using cloud platforms such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform, combined with virtualized infrastructure. This configuration enables the provisioning of virtual instances of computing resources, like servers and networks, on physical servers. Federated access management secures and controls access to corporate resources, while digital continuity management ensures the stability and reliability of digital services. Distributed computing technologies enable the sharing, selection, and aggregation of various resources, including computing power, storage, and data, across a network, typically the Internet. Parallel processing services, especially those using grid computing, are applied to process large data volumes and address complex computational tasks. Other types of services enhance interactions with users and between business processes and systems, improving operational efficiency and optimization. In sectors such as manufacturing, healthcare, and smart city development, where quick and efficient data processing is crucial, creating a flexible and highly effective system that integrates cloud computing with edge computing technologies is ideal. This combination significantly reduces data transmission delays and decreases the overall strain on network resources, optimizing data processing and expanding the system's capabilities.

Digital infrastructure creates a foundation for the effective management of **digital informational assets** – such as data, content, and knowledge – that are crucial for an enterprise and can be leveraged to support strategic development and enhance operational efficiency. Digital data management is a vital component of contemporary business strategies and encompasses a comprehensive set of policies and technologies for managing the large volumes of data generated and stored by enterprises. Specifically, the management of non-relational data involves handling data in various formats, including text, multimedia files, and data in JSON and XML formats, among others. Primarily, this data is used to enhance analytical capabilities, uncovering valuable insights, trends, and relationships that can improve business strategies. It also facilitates the personalization of products and services, forecasting, risk analysis, marketing and advertising enhancements, supply chain optimization, security enhancement, fraud detection, and acceleration of market-responsive actions. Additionally, it supports the development of new products and services and enhances collaboration and communication.

Large enterprises dealing with large data volumes use distributed data storage systems to organize secure storage and collective access to data. Enterprise search systems assist in locating relevant information within vast data pools. To achieve a unified, consistent view of data, Master Data Management (MDM) is employed-dealing with critical data, typically involving customers, products, employees, suppliers, and other aggregated enterprise data used across various departments and systems. MDM solutions and practices are essential for organizations to ensure data accuracy, facilitate informed decision-making, enhance operational processes, improve data quality, and meet regulatory requirements. Data quality management ensures the accuracy, consistency, and reliability of data. The development and implementation of data management policies and standards lead to processes for validation, quality control, and data cleansing. Enterprises must establish policies for data privacy, access, storage, security, backup, archiving, restoration, and deletion, as well as standards for data processing and exchange.

Enterprise content management encompasses a comprehensive set of activities aimed at creating, managing, storing, distributing, and archiving valuable information, including text, graphics, audio, and video materials. Content plays a key role in various management tasks such as corporate communications, public relations, brand building, promoting products and services, attracting potential customers, maintaining consumer relationships, providing service and support, disseminating corporate news, policies, and procedures, and facilitating training and staff development. It also enhances collaboration on projects. The initial step in content management involves defining the goals and target audience of the content, which helps ensure its relevance, followed by planning a content strategy that encompasses production, editing, publication, and monitoring. Content management systems simplify the creation, editing, and publication of content, as well as version control, ensuring the content remains current, compliant, and effective. The aggregation and syndication of content allow for its distribution across various platforms and channels, significantly extending its reach. Simultaneously, it is crucial to ensure the protection of copyright and intellectual property, as well as adherence to regulatory requirements related to the publication and distribution of content. Collecting and analysing feedback from users and audiences is an essential part of the process, enabling the evaluation of content effectiveness and its impact on achieving the enterprise's business objectives.

Knowledge management within an enterprise encompasses a wide range of tasks focused on the effective use of intellectual capital. This process aims not only to enhance the company's innovative potential and adaptability in response to market changes but also to improve the productivity and professional skills of its employees. It starts with identifying and gathering key knowledge that is valuable to the business from various sources, including internal documents, processes, and the experiences of employees. Key tasks in knowledge management include organizing and consolidating relevant knowledge, ensuring that all employees have access to the company's accumulated knowledge or 'collective memory,' conducting semantic searches and filtering knowledge across corporate and global information resources, and fostering collaboration among high-performing professionals in the idea generation and decision-making processes. Additionally, it is crucial to establish an environment for online interaction among distributed project and business teams, professional communities, and experts. Equally important is creating a networking environment that enhances professional development and fosters a corporate culture supportive of management and business processes.

Artificial intelligence technologies are opening new frontiers for knowledge management within enterprises, offering substantial advantages compared to traditional methods. AI-based systems provide a high level of personalization, adapting knowledge according to the unique preferences and needs of each user. Additionally, they maintain the relevance of knowledge by automatically detecting and updating it across various sources and integrating this knowledge into the enterprise's unified repository. The automation of processes for searching knowledge, analysis, and decision-making not only reduces system maintenance costs but also enhances resource efficiency. Moreover, artificial intelligence introduces adaptability and autonomy into the management of organizational knowledge, thereby transforming traditional practices in management, utilization, and value derivation from knowledge assets. This enhancement aids in leveraging gathered knowledge to support decision-making, stimulate innovation, enable strategic planning, and optimize business processes.

The digitalization of enterprise operations typically begins with the transition from analog to digital methods. However, businesses gain more significant benefits when they begin to optimize and simplify their business processes using modern technologies. This approach fosters the development of digitally intensive enterprises, which incorporate digital tools and data analytics into their daily operations. According to the OECD, digital sectors, particularly those that are highly digital-intensive, are more dynamic than other economic sectors and are major drivers of economic growth and employment [32–34]. Enterprises whose employees actively use digital tools, including in interactions with customers and suppliers, gain advantages that stimulate innovation, productivity, and growth. This shift demands a special focus on a range of entirely new challenges, such as digital marketing, managing digital customer experiences, customization and personalization in customer interactions, managing digital channels, fostering social interactions, and harnessing digital intelligence.

Digital marketing encompasses a broad set of strategies and techniques aimed at boosting brand visibility in the digital space and attracting customers. This approach includes digital brand marketing, focused on creating a strong digital image of the brand through innovative content and leveraging online platforms. Search engine optimization (SEO) plays a key role in increasing website traffic and enhancing search engine rankings. Tools such as paid search and targeted content are used to attract specific audiences through contextual advertising and personalized offers. Affiliate marketing and online advertising significantly contribute to broadening reach and capturing new customers. Managing digital campaigns, leads, and marketing offers is aimed at optimizing marketing efforts. Email and mobile marketing open new horizons for customer engagement, and marketing automation along with conversion optimization enhances the overall effectiveness of marketing initiatives and the accuracy of measuring their results.

Managing the digital customer experience requires a thorough examination and optimization of all interaction points between customers and the company in a digital environment. This approach encompasses the development of strategies from the initial brand interaction to fostering long-term engagement, aiming to ensure a consistently positive user experience throughout their digital journey. It is crucial to focus on understanding users’ needs and preferences, analyzing their behavior, and assessing their responses to various digital products and services. The design of intuitive interfaces, rigorous functionality testing, and usability assessments, as well as ongoing improvements based on data collection and user feedback, are essential tasks. These efforts are key to cultivating a seamless and rewarding digital experience, ultimately building customer loyalty to the brand.

Customization and personalization are crucial in customer engagement. Managing these interactions involves tracking individual customer behaviors, analyzing their needs and preferences in depth, and creating of individual user experiences. This continuous improvement process helps maintain customer loyalty. A vital aspect of this approach is managing customer communications, which focuses on enabling effective feedback mechanisms to enhance interaction and information sharing. Furthermore, overseeing social behavior is essential for understanding the impact of social networks and digital interactions on customer decision-making. Digital services for customers also form a core part of this strategy, making interactions with the company more convenient and accessible, ultimately boosting overall customer satisfaction.

Digital channel management entails developing strategies and techniques that enhance the efficiency of various distribution and communication channels, along with optimizing their combinations for increasing outcomes. Utilizing analytical tools allows for the measurement and optimization of each channel’s performance to maximize resource efficiency. Digital integration facilitates seamless connections and interactions between diverse business structures and channels, thus enhancing the overall customer experience. This integration also enables consumers to have continuous and consistent interactions across different devices. Collectively, these elements contribute to establishing a robust and cohesive digital presence. Managing user feedback across platforms is crucial for maintaining service quality and enhancing products or services. Moreover, integrating social media and other digital platforms creates a comprehensive communication environment where customers can find information, engage with the brand, and make purchases. Collaborating with influencers and other brands on joint marketing campaigns can effectively broaden the audience and boost sales. This strategy not only extends the brand’s digital footprint but also helps achieve strategic business objectives.

Social interaction is pivotal in cultivating customer relationships in the digital world, beginning with social monitoring — the tracking and analysis of user activities. This approach enables companies to adapt to evolving trends and consumer preferences, facilitating timely responses to their needs. Marketing through social networks and digital customer service platforms enhances active engagement and retention, fostering long-term relationships. Managing online communities, as well as addressing ratings and feedback, is critical in maintaining a positive brand image and fostering a platform for dialogue and customer engagement. Additionally, content moderation and crisis management in social media are essential for sustaining a positive reputation. Prompt and effective handling of negative situations is crucial for maintaining customer trust and loyalty.

Digital intelligence encompasses a broad range of analytical tools and methodologies designed to enhance the effectiveness of digital strategies. For instance, product similarity analysis can identify and recommend products that align with customer interests and needs. Customer reviews and client segmentation provide deeper insights into distinct user groups and their preferences, enabling companies to tailor their offerings more effectively. Analytics on conversion rates and digital marketing effectiveness help assess the success of marketing campaigns and guide adjustments to improve profitability. Big data and web analytics offer valuable insights into client behavior and their interaction with digital content. Additionally, Internet of Things (IoT) technologies allow for data collection from a variety of sensors, devices, and equipment, facilitating remote monitoring and management of connected assets. This data can be leveraged to optimize business processes, such as maintenance scheduling for equipment or managing the supply chain. Dashboards and reports visualize data and trends, supporting well-informed management decisions.

While digitization of operations focuses on supporting and enhancing key business processes, **digital transformation of business models** lays the groundwork for companies to secure unique competitive advantages by altering these models. Changes can occur at the level of individual components, the entire business model, the value chain, or the integration method of various stakeholders into a value-added network. The most significant business model transformations are often linked to the development of digital platforms, which establish the technological basis for creating an e-business ecosystem with these main characteristics:

− it features an open environment with clearly defined formal and informal rules and guidelines;

− the roles of participants are not fixed and can vary.

− algorithmic management is employed, where the right and responsibility for assigning tasks and making decisions are granted to platform control algorithms with minimal human intervention. These algorithms are capable of self-learning from accumulated data.

− there is mutual benefit (not exclusively economic) for all participants, which operates on a win-win principle and is proportional to the number of participants involved (scale of the platform).

Service business models and marketplaces are increasingly common and show great promise. Service business models, particularly those operating under the Everything-as-a-Service (XaaS) concept, utilize resources rather than purchasing them outright. Offerings include Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Data Center-as-a-Service (DCaaS), Software-as-a-Service (SaaS), Desktop-as-a-Service (DaaS), Banking-as-a-Service (BaaS), and artificial intelligence solutions. These are variations of the traditional subscription business model where clients pay a fixed fee, monthly or annually, for access to a product or service tailored to their needs. Currently, the most prevalent model is SaaS (Software-as-a-Service or «Software on Demand»), which allows multiple clients to remotely use an application hosted in the cloud, completely managed by the provider. Ownership of the product stays with the supplier company, which is responsible for selecting and managing the products, providing service maintenance, and monitoring user experience, usage parameters, and characteristics to enhance products and services. The «economy of scale» achieved through a single software core used by all clients helps save resources and reduce service costs. Another advantage is the prevention of unauthorized software usage. For consumers, this model is attractive because it eliminates the need to invest heavily in hardware and software, replacing substantial upfront costs with more manageable periodic payments and offering the flexibility to adjust resource consumption dynamically. This model is generally not suitable for applications requiring highly specific customizations or tasks that involve the accumulation and processing of sensitive information.

Product-as-a-Service (PaaS) models provide customers with a comprehensive suite of products and services. Alongside the product itself, customers receive instructional support, advice, or other assistance to enhance their product experience, as well as service maintenance and product updates. One of the services may be the opportunity to learn from the experience of using the product or contacting the company based on customer feedback. In certain scenarios, this model is designed to create a complex array of products and services that motivates customers to make new purchases or further engage with the company. As a result, the company can implement various pricing strategies. Under the Freemium Model, the product or service is available at no cost, with charges applied only for advanced functionalities or additional products and services. Alternatively, the payment could be in the form of agreeing to view advertisements, which generates revenue for the provider. In the Free Model, the provider offers the product or service for free but earns revenue from advertising or by selling data about customer preferences, which can later be used for targeted advertising.

A marketplace is a digital platform that serves as an intermediary between suppliers (sellers) and consumers (buyers). This model enables the platform to earn revenue through advertising, transaction fees (commissions), charges for additional services provided to participants, or fixed membership fees. Additionally, the data collected are utilized to enhance services. A specific example of this business model includes hypermarkets, which offer a broad range of products and services, some of which are exclusive, and pyramids that facilitate cooperation with third parties, especially goods sellers. Companies may also integrate elements from multiple business models. For consumers, a marketplace offers a broader selection of products at potentially lower prices. For suppliers, it offers a quick way to start selling and to enter both local and international markets, all within a supportive and secure environment. The owning company manages the website and mobile apps for accessing the marketplace, conducts marketing activities, strives to attract users (both buyers and sellers), acts as a market operator, ensures transaction security, and handles various administrative tasks.

Digital platforms have become the foundation for new business models across various industries. They encompass a broad spectrum of sectors, including transportation, exemplified by Uber, and delivery, highlighted by Glovo. In tourism, platforms like Airbnb and Booking have redefined accommodation booking practices. The financial sector is also experiencing a digital transformation with platforms such as Afluenta, KiaKia, and Lending Club, which deliver innovative financial services. The entertainment industry has been transformed by services like Netflix and Spotify, while media giants such as Bloomberg and Reuters leverage digital technologies for news distribution. The advertising and marketing sectors have undergone significant changes due to platforms like Baidu, Facebook, Google, and OLX. The review and recommendation industry is being reshaped, as demonstrated by Tripadvisor. In education, platforms such as Coursera, edX, and Udacity are creating new opportunities for learning and development. Meanwhile, Upwork and TaskRabbit are pioneering new horizons for the labour market and freelancing.

Conclusions

The development of digital platforms underscores the critical importance of aligning digitalization initiatives with the strategic business objectives of a company. Digital infrastructure and digital information assets, essential for achieving digital transformation goals, must be seamlessly integrated into all business operations. The digitization of operations and the shift towards new business models should be carried out with consideration of both the short-term and long-term strategic goals of the company. In this context, managing digital programs and projects involves detailed planning and control over complex digital initiatives, as well as the coordination of all digital resources and processes. It also requires effective knowledge exchange with partners and stakeholders. Furthermore, it is crucial to ensure the ongoing innovation in digital technologies to enhance products, services, and processes, boost competitiveness, exploit new digital opportunities, and adapt to changing market conditions and customer expectations.

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