DIGITAL TRANSFORMATION: FROM INFORMATIZATION TO ARTIFICIAL INTELLIGENCE IN ADMINISTRATIVE SERVICES IN UKRAINE

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Abstract. The study identifies and substantiates the periods of digital transformation and introduction of artificial intelligence in administrative services in Ukraine with a focus on regulatory and legal support. The periods of digital transformation in Ukraine are divided into informatization (1991-2000), digitalization (2000-2019), and digital transformation (2019-present). Informatization includes the creation of national information systems and telecommunications infrastructure. Digitalization is characterized by data integration and process automation, such as the launch of e-government, e-democracy, decentralization, and automation of public services. Digital transformation includes the strategic restructuring of social and business processes using technologies such as the Internet of Things, artificial intelligence, cloud computing, big data, and others. To formulate the periods of digital transformation, we considered global trends in the development of AI in the world. Several periodization's were taken into account, including the ten-year periodization of AI development, which covers key stages: from its inception in the 1950s, the ups and downs of public interest in the 70s and 90s, to the modern era of large language models. Another periodization, based on technological and investment criteria, identifies such stages as the formation of machine intelligence, the heyday of expert systems, the "winter of AI," the era of deep learning, and the "spring of AI." This study highlights the complexity and multifactorial nature of the processes of AI formation and digital transformation. Particular attention is paid to the analysis of the legal and regulatory framework in these areas in Ukraine. This makes it possible not only to assess the achievements but also to identify potential vectors of development in the context of sustainable development.

Keywords: digital transformation, artificial intelligence, administrative legal relations, administrative services, automation, informatization, digitalization, information law, sustainable development.

In the scientific literature, there are several characteristics and time intervals for the formation and development of artificial intelligence (AI) technologies. These are the ten-year periodization of AI development, the technological and investment periodization, and the four-stage periodization. The criteria for determining the

beginning of a period and its end are based on various factors. Let us briefly analyse these three periodization's.

1. The ten-year periodization of AI development will include the following periods.

1950`s — the beginning of the AI era.

1960`s — a period of optimistic expectations.

1970`s — the winter of AI.

1980`s — revival.

1990`s — revolution in computing.

2000`s — the beginning of a new wave.

2010`s — the era of deep learning.

2020`s — AI in everyday life.

The criteria for establishing the period are the destylite period of time, and the name of the period is associated with technological breakthroughs or the decline of public interest in the development of AI technologies.

2. **The technological and investment periodization of AI development has other periods:**

1930-1940 - the ideological stage, the human brain as an electrical network of neurons that can be reproduced.

1941-1948 — algorithmic and cybernetic formation of machine intelligence.

1956-1974 — birth of AI at the Dartmouth Seminar.

1974-1980 — the first AI winter.

1980-1987 — emergence of expert systems and neural networks.

1987-1993 — the second AI winter.

1993-2010 — intelligent agents and imperceptible mass integration of AI.

2011-present - the era of massive AI adoption.

2011-2015 — deep learning and big data.

2016-2024 — the spring of AI and big language models.

In this periodization, the beginning and end of a certain period are determined by various factors. These include the availability of large funding for AI projects; development of new mathematical methods of computing; identification of data dependence for scaling projects, which was a prerequisite for losing interest in AI development; formation and completion of the cycle of expectations; emergence of next-generation computers (personal computers with high power instead of special hardware); emergence of breakthrough scientific publications with new hypotheses about the potential of AI; victories in intellectual games (chess and go); changes in learning paradigms since 1950, etc.

Establishment of these periods and key facts of AI formation and technological development is not absolute, universal, and reasonable. Analysing and comparing the criteria of these separate periodization's only allows us to see the complexity of the processes of AI technology development and the factors that have influenced them for the better part of a century. From the stage of mass introduction of intelligent agents (2011) to the widespread introduction of AI in all spheres of social life (2018), we can

highlight the significant intensification of the period, where more technological breakthroughs occur in 1 year than in the previous several decades.

3. A four-stage periodization of AI development: early stage, lull period, AI renaissance, and the era of AI in the new millennium. Each of these stages has its own peculiarities and is accompanied by unique achievements and progress.

1943-1955 — is **the early period of AI development**. It is associated with the emergence and research of the first artificial neural networks that simulated the nervous system *(McCulloch-Pitts model, 1943)* and the development of Alan Turing's test (1950) to determine machine intelligence, which showed the possibility of modelling neural activity.

1956-1980 — is **a period of calm**. The theoretical basis for further research was formed, namely the emergence of the idea of expert systems - logical systems based on formal rules and knowledge bases. In the initial period of AI development, there were high expectations for the rapid achievement of full-fledged artificial intelligence. However, the realization of these expectations turned out to be much more difficult than anticipated. Limited computational and financial resources were one of the reasons for the protracted period of AI development (known as the first and second "Winter of AI"). At that time, computers had limited processing power and memory capacity. This made it difficult to solve complex problems and required additional resources for AI research.

1980-2000 — the period of AI revival. During this period, machine learning methods, neural networks, and expert systems were actively used. The main achievements include the development of deep neural networks that became the basis for image processing, speech recognition, and text processing models. These first natural language processing programs were very far from modern systems, but the field of algorithm optimization - research aimed at improving methods for solving AI problems - was formed.

2000 to the present is the **AI era of the new millennium**. Artificial intelligence has become an integral part of our daily lives. The application of AI has spread to many industries, including automotive, medical, financial, and legal. This period has seen an explosive growth in data and computing power, which has enabled the application of deep learning methods and the development of autonomous systems. Each of these stages emphasizes the constant progress of AI and its increasing role in the modern world *(Yashchenko, 2024)*.

In the fourth stage, we can distinguish two stages of AI development.

2011 - 2015 — the **stage of deep learning and big data**. The use of terabytes of data to study and improve artificial intelligence models led to the integration of AI with Internet of Things devices, which led to the development of smart homes, smart cities, and control systems. Autonomous systems, robots and autonomous vehicles equipped with artificial intelligence have become a reality. The use of AI in augmented and virtual reality (AR) has opened new opportunities in education, medicine, entertainment, healthcare, and the entertainment industry.

2016 - 2024 — the **stage of large language models** ("AI Spring"). The beginning of this stage is associated with the founding of OpenAI in 2016-2017. 2018

— the emergence of a language model for natural language processing GPT (Generative Pre-trained Transformer) is a deep learning model that can generate the next word or phrase on based on the previous context. Models for converting a text query into a DALL-E image (2021), as well as speech synthesis.

The study of AI development periods in different sources may have different periods and stages depending on the expectation cycle (a concept developed by the technology and innovation research company Gartner Group). The expectations cycle starts from the moment a technological trigger appears - a new technology - to the formation of public expectations, testing, identification of shortcomings, loss of public interest in the innovation, elimination of shortcomings and mass commercialization, and ends with the perception of technology as an integral part of everyday life *(Fenn, 1995)*.

With this understanding, we will analyse the periods of digital transformation in Ukraine by the criterion of the adoption of regulatory frameworks for a particular sector. At the same time, we also realize that legal support appears much later than the emergence of relevant technologies. Therefore, to form a unified approach to the beginning and end of the relevant period, we will analyse how the subjects of legal regulation of technologies have changed at the state and public levels.

In analysing the legal support of the ICT sector in Ukraine, we will terminologically distinguish three definitions: informatization, digitalization, and digital transformation.

Informatization is a set of organizational, legal, political, socio-economic, scientific, technical, and technological processes for the development of digital technologies *(On the National Informatization Program, 2022)*.

Digitalization is the saturation of the physical world with specific ICT solutions, devices, and tools that ensure interaction in the information environment to meet personal, public, and state interests (*Concept of Development of the Digital Economy and Society of Ukraine for 2018-2020, 2018*).

Digital transformation — is an independent process or a process within the framework of social transformation that takes place on the basis of the maximum use of digital technologies, such as Internet technologies, the Internet of Things, Industry 4.0, artificial intelligence, robotics, big data processing, cloud computing and others in order to increase the efficiency of group and individual activities of the human community *(Baranov and oth, 2024, p. 32)*

According to the regulatory and legal support of these processes, the periods of informatization, digitalization and digital transformation in Ukraine can be presented in the following order:

1991 - 2000 — the period of informatization, characterized by the creation of national information systems, development of telecommunications infrastructure, digitization of documents and transition to electronic mail systems (On the National Program of Informatization, 1998).

2000 - 2019 — the period of digitalization, characterized by the transition from analog to digital technologies, which allows not only storing information but also integrating it into unified systems for process automation (since 2005, electronic

document management systems have been actively implemented in government agencies, 2013 - the beginning of the massive use of digital technologies in public services, such as the Prozoro system for public procurement).

2019 and up to now — the period of digital transformation, characterized by profound changes in all spheres of society, changes in business and operational processes, and new ways of interaction between entities and technologies.

Informatization and digitalization can be viewed as preliminary, technical stages in which the technical infrastructure for working with data is built, while digital transformation is a strategic process that covers a complete restructuring of activities and processes by realizing the potential of digital technologies.

This is a general characteristic of the periods of informatization, digitalization, and digital transformation. For each industry in these periods, key stages and events can be identified that are associated with the emergence of new ways of realizing social relations. Based on this periodization, we will distinguish several stages for the legal industry, considering the introduction of various technological solutions that ensured the implementation of legal work.

Since 1998 - the stage of formation of the system of national information resources. Adoption of the National Program of Informatization to create a nationwide network of information support. Such informatization tasks were formed in 1998 *(On the National Informatization Program, 1998)*. In 2022, a new law on the National Informatization Program was adopted, which defined the following tasks: development, implementation and application of information and communication technologies in public administration, local self-government and public life; development of e-government and e-democracy; improvement of the procedure for providing public (electronic public) services; organization of information interaction between state bodies and *(On the National Informatization Program, 2022)*.

Since 2001, the stage of access to legal information has been in progress. Let's trace the development of state information resources of the legislative, executive and judicial branches of government in chronological order.

This stage is characterized by the emergence of specialized databases, such as Legislation, which contains current versions of legal acts, with the ability to view the texts of previous and future versions of laws and track all lawmaking work. The consolidation of separate information websites of the legislative *(Regulation on the Website of the Verkhovna Rada of Ukraine in the Global Information Network Internet, 2001)*, executive *(Procedure for Publication of Information on the Activities of Executive Bodies on the Internet, 2002)*, and judicial branches of power *(On Organizational Support for the Functioning of the Web Portal "Judicial Authority of Ukraine", 2014)*, which were mostly information stands on the Internet for obtaining information, into multifunctional single web portals with the possibility of information interaction (submission of requests, information and generation of receipts on required payments). Electronic registries are emerging and being improved to allow for data verification.

The emergence of these databases and their technological development (adding search functions and filters) simplifies the process of finding legal information.

Since 2015, the e-governance stage has been characterized by the introduction of digital technologies in management processes and interaction between citizens and the state, and processes such as e-Government, e-Services, e-Commerce, e-Democracy, and open data are actively developing.

Since 2019, the stage of service delivery automation has been underway. For all Ukrainians, the most tangible service of this period is the emergence of the DIIA-portal, which allows them to receive electronic services *(Issues of the Unified State Web Portal of Electronic Services and the Register of Administrative Services, 2019)*. At the initial stage, the portal only had information on the required documents and authorities, and the timeframe for providing the service, as well as information on the cost or free of charge. Subsequently, forms of the required documents and the possibility of submitting them with a qualified electronic signature without physically visiting the Centres for Administrative Services or other public authorities were added. This stage is characterized by two-way information interaction between the government and the citizen.

Since 2022, the stage of automatic receipt of services has included the automation of "complex services" that require a change in the status of a citizen in unified state registers, for example, the registration action in the automatic mode of state registration of an individual as an entrepreneur without the participation of a state registrar *(On State Registration of Legal Entities, Individual Entrepreneurs and Public Organizations, 2024, Article 25-1)*. This process has radically changed the procedure and the subjective composition of participants, on the one hand simplifying operational decisions, and on the other hand posing a serious challenge to the legal system *(Baranov and Dubniak, 2023)*. In the future, many more such services will appear, considering the legislative innovation that requires administrative bodies to take measures to consider cases automatically *(On Administrative Procedure, 2023)*.

The stage of application of artificial intelligence technologies (from 2011, the private sector, from 2020 - certain areas of the legal profession in Ukraine, from 2024 - public services).

In the private sector, the widespread use of various devices began in 2011 (the massive introduction of voice assistants with speech recognition functions, such as Siri from Apple, Alexa from the retail giant Amazon). This stage is characterized by the addition of artificial intelligence technologies to registries and databases with legal information. The peculiarity of such software solutions is their commercial nature (paid subscription for the use of services) and the ability to obtain predictive analytics. For example, the addition of artificial intelligence technology to the registers of court decisions allows for predictive analytics, i.e., the likelihood of a particular decision being made by a particular judge within a certain category of cases. Such a forecast is made based on the analysis of the texts of decisions of a particular judge in a particular category of cases. By filling in the search parameters

in the program (available evidence in the case, specific circumstances, the period of the relationship and the decision, etc.), artificial intelligence technologies can provide the probability of a positive or negative decision in a matter of minutes, as well as an analysis of the client's specific situation. For comparison, with open databases of court decisions, a lawyer can also analyse a dozen cases and make an approximate forecast for the client regarding the decision. However, such a service can take, depending on the complexity of the case, from several hours to several weeks due to the significant amount of data that must be analysed by a human.

AI technologies are also used to analyse contractual provisions. In one experiment, when analysing the text of a 300-page contract, artificial intelligence produced an analysis with an accuracy of 94% in 26 seconds. A team of 20 lawyers analysed the same contract in 1 hour and 32 minutes, with an accuracy of 85% (*Artificiallawyer, 2018*).

Since 2020, the use of AI in the legal profession in Ukraine has gained wide scientific popularity among legal scholars. The problems of using artificial intelligence in the field of intellectual property, including the protection of objects created by AI and the patenting of inventions, have been studied *(Dubniak, 2019)*. In the judicial and law enforcement systems, the problem of predicting a criminal's recidivism when a judge decides *(Borchevska, 2023)*, and the use of AI to prevent crime *(Buhera, 2021)*, the introduction of AI in judicial proceedings *(Udovenko, 2023)* and the notary process *(Karamza, 2021)*.

Since 2024, Ukraine has created legal grounds for the **use of artificial intelligence technologies when using the functionality of the DIIA portal** *(Issues of the Unified State Web Portal of Electronic Services and the Register of Administrative Services, 2024)*.

The stages of development of information technology in law are listed to illustrate the areas that can be automated, which, on the one hand, simplifies and speeds up the process of providing legal services. On the other hand, it should demonstrate that not every technological solution is the result of the use of artificial intelligence. Currently, in most cases, these are examples of simple or complex automation of certain tasks and services.

Conclusions.

1. The development of AI is characterized by complex dynamics, which is reflected in different periodization's. The periods are based on technological breakthroughs, levels of financial support, and public expectations. From the ideological formation to the mass adoption of AI, the progress of this industry is uneven and cyclical.

Each periodization depends on the chosen criterion: funding, technical breakthroughs, changes in public expectations, or legal regulation. This approach shows the complexity of the interaction between society, technology, and legal instruments.

2. Since 2011, there has been a rapid acceleration in the pace of development, with more breakthroughs in a year than in the previous few decades. This reflects

new approaches to AI training (deep learning, transformational architectures, large language models).

3. Given the heterogeneous approaches to periodizing the development of AI technologies in the world, we have identified three periods of digital transformation in Ukraine

- Informatization (1991-2000) - infrastructure development.

- Digitalization (2000-2019) - the introduction of ICT in public administration and services.

- Digital transformation (2019 - present) - strategic changes in all spheres of public life due to AI and other technologies.

4. When studying the legal regulation of the introduction of new technologies in the public sector, we found a significant time lag from the moment of new technologies before their actual widespread use, which creates challenges for the integration of innovations into the legal framework. In fact, legalization occurs after the technologies are widely used. In our opinion, given the identification of legal problems, their resolution by the law could have been done earlier.

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