Electronic scientific and practical journal

INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

#24 (2024)
April '24

WWW.SMART-SCM.ORG
ISSN 2708-3195
DOI.ORG/10.46783/SMART-SCM/2024-24

ISSN 2708-3195

Electronic scientific and practical collection
INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Electronic scientific and practical publication in economic sciences

Electronic scientifically and practical journal “Intellectualization of logistics and Supply Chain Management” included in the list of scientific publications of Ukraine in the field of economic sciences (category "B"): **Order of the Ministry of Education and Culture of Ukraine dated October 10, 2022 No. 894 (Appendix 2)**

Field of science: Economic.
Specialties: 051 – Economics; 073 – Management

ISSN 2708-3195
DOI: https://doi.org/10.46783/smart-scm/2024-24

The electronic magazine is included in the international scientometric databases:
Index Copernicus, Google Scholar

Released 6 times a year

№ 24 (2024)
April 2024

Kyiv - 2024

Founder: Viold Limited Liability Company

The electronic scientific and practical journal is registered in international scientometric data bases, repositories and search engines. The main characteristic of the edition is the index of scientometric databases, which reflects the importance and effectiveness of scientific publications using indicators such as the quotation index, h-index and factor impact (the number of quotations within two years after publishing).

In 2020, the International Center for Periodicals (ISSN International Center, Paris) included the Electronic Scientific and Practical Edition "Intellectualization of logistics and Supply Chain Management" in the international register of periodicals and provided it with a numerical code of international identification: ISSN 2708-3195 (Online).

Recommended for dissemination on the Internet by the Academic Council of the Department of Logistics NAU (No. 7 of February 26, 2020). Released 6 times a year. Editions references are required. The view of the editorial board does not always coincide with that of the authors.

Electronic scientifically and practical journal "Intellectualization of logistics and Supply Chain Management" included in the list of scientific publications of Ukraine in the field of economic sciences (category "B"): ***Order of the Ministry of Education and Culture of Ukraine dated October 10, 2022 No. 894 (Appendix 2)***

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DOI: https://doi.org/10.46783/smart-scm/2024-24
e-mail: support@smart-scm.org

тел.: (063) 593-30-41
https://smart-scm.org

Contents

INTRODUCTION

We are happy to invite you to get acquainted with the first issue of the new scientific and practical publication "Intellectualization of Logistics and Supply Chain Management".

We strongly believe that the launch of this magazine indicates the objective need to rethink a wide range of issues related to the development of theory and practice in logistics and supply chain management, awareness of the need to unite the scientific community and logistics practitioners, dissemination of modern knowledge and best practices for innovative development of the logistics services market.

The first issue of the magazine is published at a difficult time. The global coronavirus pandemic and the deep economic crisis have significantly worsened business activity in the world. Currently, global supply chains are collapsing, international trade is declining, and competition between global and regional logistics operators is intensifying. The most common thesis is that the world will never be the same again. Industry experts predict the emergence of new, more flexible and adaptive supply chain management strategies and approaches to logistics business process management. The trend towards collaborations, cooperation and unification of services is emerging, comprehensive proposals for clients are being developed. There is increasing talk about the need to build bimodal supply chains, which involves the development of different decision-making scenarios: the traditional approach - cost-effective efficiency, low risk, high predictability; a new approach "second mode" - rapid recognition of opportunities, adaptability, willingness to solve unexpected problems and look for new opportunities.

Radical transformations of the global and national markets for logistics services require appropriate scientific support. Logistics science has a special role to play in this process. Initiating the emergence of a new journal, we decided to focus on its coverage of problematic aspects of the formation and development of logistics systems at the micro, mezo and macro levels, supply chain management, digitization of logistics, methods and tools for optimizing processes in logistics and supply chains, sociopsychology relations and network interaction of enterprises using cloud technologies, artificial intelligence, e-learning, neural business process management systems, etc.

Therefore, we invite scientists, researchers and business representatives, as well as our colleagues from abroad, to cooperate and present the results of scientific research, to discus and debate on them, to work together to develop the scientific theory of logistics and promote mutual intellectual enrichment.

We hope that the new scientific publication will become a theoretical guide for young researchers and representatives of other fields.

HRYHORAK Mariia
Chief Editor

UDC 629.7.067(091)(477)(045) DOI: https://doi.org/10.46783/smart-scm/2024-24-1
JEL Classification: M15, O9.
Received: 10 February 2024

Grebennikov V.M. PhD (Historical Sciences), Associate Professor, National Aviation University (Ukraine)

ORCID –
Researcher ID –
Scopus author id: –

Bugayko D.O. Doctor of Science (Economics), Professor, Corresponding Member of the Academy of Economic Sciences of Ukraine, Vice - Director of ES International Cooperation and Education Institute, Instructor of ICAO Institute, Professor of the Logistics Department, National Aviation University (Ukraine)

ORCID – 0000-0002-3240-2501
Researcher ID – ABF-5564-2021
Scopus author id: – 57216582348

RETRO ANALYSIS OF THE AVIATION SAFETY SYSTEMS DEVELOPMENT IN UKRAINE

Volodymyr Grebennikov. Dmytro Bugayko. "Retro analysis of the development of the aviation security system in Ukraine". *Various measures to ensure the safety of civil aviation flights in Ukraine from the time of its inception to the present are considered in a historical aspect at certain stages of activity, mainly organizational, scientific and technical and personal factors regarding the minimization of risks in civil aviation. The article confirms that at all stages of the more than 100-year history of civil aviation of Ukraine, various measures were constantly taken to ensure flight safety and minimize risks in aviation, especially since the second half of the 20th century. Innovative achievements of designers, scientists, engineers and technicians, training of highly qualified aviation specialists at the national and international level have become the achievement of global aviation. The integration of domestic aviation into the European and world community contributed to the strengthening of aviation safety in Ukraine.*

Keywords*:* retro analysis, aviation safety, civil aviation of Ukraine, risk management, history

Володимир Гребенніков. Дмитро Бугайко. «Ретро аналіз розвитку системи безпеки авіації в Україні». *Розглядаються в історичному аспекті різнопланові заходи забезпечення безпеки польотів цивільної авіації в Україні з часу її започаткування до сьогодення за визначеними етапами діяльності, головним чином організаційні, науково-технічні та особистісті фактори щодо мінімізації ризиків в цивільній авіації. Стаття підьверджує, що на всіх етапах понад 100-річної історії цивільної авіації України постійно проводилися різнопланові заходи по забезпеченню безпеки польотів, мінімізації ризиків в авіації особливо з другої половини XX ст. Інноваційні досягнення конструкторів, науковців, інженерів і техніків, підготовка висококваліфікованих авіаційних фахівців на національному та міжнародному рівні стали здобутком глобальної авіації. Інтеграція вітчизняної авіації до європейської та світової спільноти сприяли посиленню безпеки авіації в Україні.*

Ключові слова: ретро аналіз, безпека авіації, цивільна авіація України, ризик менеджмент, історія

Introduction. Since the emergence of world and domestic aviation, the problem of flight safety has also arisen. The first manned flight of brothers Orville and Wilbur Wright on December 17, 1903 in the "Flyer" airplane is considered the beginning of aviation. It is characteristic that the first aviation accident in history due to an aircraft defect occurred during the test flight of O. Wright on September 17, 1908, who was injured, and the passenger supervisor, Lieutenant of the US Army T. Selfridge, died [1].

The initial process of formation and development of aviation in Ukraine took place on a public basis, on the initiative and material resources of enthusiasts, engineers, scientists who selflessly embarked on the thorny path of conquerors of the sky, risking even their lives during the tests of their experimental aircraft. In Ukraine, in 1908-1911, public aviation organizations were created in Odesa, Kyiv, Kharkiv, Lviv and other cities, which had their own organizational structures, statutes, regulations and programs, and carried out multi-faceted activities for the development of aviation. The authorities reacted to this only by the fact that, after a "comprehensive review by a special interdepartmental commission", the Deputy Minister of Internal Affairs, the commander of the Separate Corps of Gendarmes, issued a secret circular on August 12, 1909, obliging the heads of the provincial gendarme departments and security departments to establish "unrelenting supervision of flights", "aviators and generally persons learning the art of aeronautics", as well as to register the personal composition of all aero clubs and "conduct covert supervision" of their members [2]. The first flights in Kyiv in 1910 by members of the Kyiv Aeronautical Society (hereinafter - KAS) on airplanes designed by KPI professor O. Kudashev in Kyiv on June 5 and aircraft designer I. Sikorskyi on June 16 actually started aviation in Ukraine. Simultaneously with the emergence of domestic aviation, the problem of flight safety immediately arose, since aviation accidents began to lead to both the loss of human lives and considerable material damage.

Analysis of recent research and publications. Flight safety issues were considered in publications on the history of domestic aviation by many authors. Among them are Savin V.S., Trotsenko A.M., Horyashko A.M., Kharuk A.I., Maraev R.V. etc. The research of a number of scientists - V.I. Tokareva, G.Y. Kasperovych, M.V. Karpenko, F.I. Skrypnyk, M.G. Kovtyukha, M.F. Davydenko became a significant achievement from this problem. etc. This topic of the modern period was covered quite fundamentally in the publications of research scientists V.P. Babak, S.O. Dmitrieva, M.S. Kulyk, V.P. Kharchenko, and F.I. Yanovsky. etc. Administrative and legal of civil aviation flights of Ukraine is presented in the works of legal experts Bagan Y.Y., Sobakary A.O., Filippov A.V., Zhukov S.I. etc. However, in the historical aspect, the problem of the safety of civil aviation flights in Ukraine was not specifically and comprehensively investigated. The works of Y. Kharazishvili, D. Bugayko, and V. Lyashenko [15, 39 – 41] are devoted to the strategic management of air transport safety.

The purpose of the article: to highlight in historical retrospect, according to the stages of development of domestic aviation, the main measures to ensure flight safety in Ukraine.

Presentation of the main research material.

Until 1917. At the first stage of the development of Ukrainian aviation (this is the second decade of the 20th century), it was represented by experimental aircraft created by members of the aviation associations of the designers O. Kudashev, I. Sikorskyi, D. Grigorovich, F. Bilinkin, V. Iordan, O. Karpeka,

the Kasyanenko brothers, O. . During the period from 1909 to 1912, about 40 different types of aircraft were created by Kyiv aviators alone, which were registered and belonged to members of the Kyiv Aviation Society (KAS) [3, p.29,49]. By 1914, 13 airplanes were built by aviation enthusiasts in Galicia [4, p.70]. All of them were used sporadically for experimental, test and demonstration flights, including with passengers. The flights, in particular in Kyiv, were carried out with the knowledge and permission of the KAS Sports Committee at low altitudes and short distances. That is, the organizational factor of ensuring flight safety was taken care of by civil aviation associations.

At the same time, state control was exercised only over military aviation, which was mainly equipped with foreign aircraft, and the first government regulations regarding aviation were the 1912 decree on prohibited zones and the government decision of June 18, 1914 on the prohibition of flights across the western border. The creation of a system of air law standards has just begun to take shape [5, 26].

Flight safety at the beginning of the 20th century depended mainly on two factors: 1. flight-technical - safe operation of the aircraft, efficiency of all its units and systems; 2. subjective, human (personal) - the ability to control the flight of an aircraft and its high-quality maintenance.

It was the flight-technical factor at the dawn of aviation that was the most difficult, since the creation of aircraft was carried out independently by pioneer designers based on original projects at their own expense, without financial support from the state and without sufficient scientific and technical justification. The construction of safer types of aircraft was facilitated by certain foreign experience, conducting experimental experiments in small aerodynamic laboratories developed by the inventors themselves, in particular I. Sikorskyi, V. Grigoryev, G. Proskura, as well as the organization of exhibitions, reports on aviation issues by members of societies, acquaintance with special literature, including foreign literature, as was the case in the Kyiv Aeronautical Society. It was here that his supervisor, Professor M.B. Delaunay of KPI, actively worked on the publication of literature on the problems of aviation and aviation. With his participation, the "Collection of Articles on Aeronautics" was published, and from March 1914, the magazine "Automotive Life and Aviation" was published. In Kharkiv, since September 1911, with the participation of the members of the Aeronautical Department of the Kharkiv RTT Department (chairman G. Proskura), the monthly aviation magazine " Heavier than air" was published.

Kyiv designers, working on the thorough development of the first aircraft, promoted their exclusive technical innovations in the latest aircraft models. Thus, O. Kudashev, in the design of another aircraft "Kudashev-2" (1910), installed a heavier engine ("Gnome" at 50 hp) and first stagnated the arc landing gear. This type of chassis was immediately proposed by the French for their airplane "Duperdussin", as it was widely used in flight [6, p.29].

Glorious aircraft designer I. Sikorsky, creating his own flights, consistently recognized the reliability of their design, the safety of airplanes and the comfort of passengers. "The first time I was able to rise was on the 16th of November 1910 on the BIS-2 (S-2) biplane and the advanced structures became more thorough. On the plane - S-5 12 June 1911 r. I. Sikorsky made flight with a passenger on board. He rememdered: "I especially thought about the ways of increasing the reliability of flying pilots after the spring of 1911" [7].

All-worldly glory I. Sikorsky was brought the world's first powered giant – "Russian Vitiaz" (b. 1913). After the mechanical failure, 11th June 1913. (having hit the new one with the broken engine of another aircraft flying over it), creating a new gigantic aircraft. This flight under the name "Illya Muromets" with comfortable washrooms for 16 passengers first rose in the air in 1913. It were possible

thaks to structural improvements and new Argus engines of 140 and 125 hp, dated 1914. A whole series of flight records were set in terms of payload, height and flying distance. The following is supported by a fairly safe design of the airframe - when two motors are connected, the airborne motors are connected without losing height [6]. It was produced serially in a variety of modifications, such as a bomber and a hydroplane (B, V, D, E) until 1919. The significance of the particular (human) factor first began to emerge in the early 20th century. foreign fakhivtsi. In 1910 Previously, the German scholar G. Münsterberg formulated and vindicated the concept of "special factor" in scientific literature. In the Russian Empire since 1912. The training began to become a military pilot under the hour of flight, as you can see in the article "Psychophysiological state of aeronauts during flight," which was published in the "Military Collection" (1912, No. 3) [8].

At the dawn of the emergence of aviation in the large organizations of Ukraine, the human factor was given importance to respect, which later became important, especially after the creation of the dismantled air transport system. For example, in the KAS they expanded knowledge of overseas aviators, scientific and technical knowledge, discussed aircraft nutrition, including with the participation of military aviators, including the 7th Air Navigation Company. All flights that were completed by non-military pilots in Kyiv were performed on registered members of the KAS by the Sports Committee and with its permission [4, p.49].

During the First Word War, the same military aviators also took care of the power supply for flights and the safe management of air flows. Illustrative in this regard is the activity of the artillery lieutenant P. Nesterov, who was born in 1910. saturated with aviation and in 1912 having given up the title of military pilot. During training flights over Warsaw, he showed his talent as an experimenter: having gained an altitude 1600 m. [9]. In his work "On the interaction of depth and direction rudders at significant roll angles," P. Nesterov was the first to demonstrate the possibility of making turns with a roll of more than 45 degrees. Having become the commander of the 11th air squadron, he ordered the start of flights with deep turns and landing with the engine running in the designated area behind him. P. Nesterov 27 serpnya (9 vesnya) 1913 r. over the Siretsk military airfield, which became the first "dead loop" in the world and went down in history as the founder of great aeronautics. KAS awarded him a gold medal "For scientific solving the problem of controlling an airplane during vertical rolls and the willingness to sacrifice one's life for science" [4, p.46-47].

At the dawn of the emergence of aviation, there was a serious problem with the entry of the aircraft into a spin, which ended in disaster. This problem solved in 1916. commander of the military division at the Kacza military school of aviation K.K Artseulov, who has extensive theoretical knowledge of aerodynamics. The situation became even worse when in this section of 8 aircaft for flights, 6 broke in a short time due to a corkscrew. In October 1916 r. K.K Artseulov on the Newport-21 flyer ascended to an altitude of 2000 m, turning off the engine and flying into an overhead spin, and at an altitude of 600 m flying from a dive to a distance, successfully repeating the same maneuver. The impossibility of recovering from a spin was introduced into the aviation school program [3, p.74].

During the First World War, volunteer pilots transferred to military service, restored the army's crews for aircraft parts, which had already spent 3-4 months of the war on a large number of pilots were lost. [4, p.70-71,74].

In the period from 1917 to 1920, all governments created in Ukraine at that time formed aviation units, but in fact aviation was used episodically and not effectively enough. Wear and tear of equipment led to numerous accidents. Only in 1918-1920, there were 420 disasters in which more pilots died than in air battles and from ground fire [10, c.85]. Flight safety issues have become relevant for all aviation countries of the world. Taking this

into account, in 1919 the non-governmental International Air Traffic Association was created in The Hague, which over the years was transformed into the International Air Transport Association (IATA). On the International Air Traffic Association first assembly in Paris developed the minimum requirements for an international standard aimed at ensuring flight safety. However, the draft convention prepared in 1925 was never signed.

The flight safety system at each new stage of the development of national aviation had its own characteristics. They were related to various types of aircraft, the level of their scientific and technical support, the qualifications of pilots and technical workers, controllers, airport equipment, the intensity of flights, the number of passenger and cargo transportations, etc.

The 1920s and 1940s became a new period in the activity of civil aviation in Ukraine. In the 20s, it was actually formed as a branch of the economy. The instruction of the Civil Air Fleet Inspectorate regarding the implementation of flights was developed from September 20, 1923 [5, p. 28-39].

The use of aviation gradually improved and expanded, especially in the 1930s, not only for the transportation of mail, cargo and passengers on domestic and international airlines, but also for use in medicine, rural, forestry and other areas of the economy, in sanitary and epidemiological, rescue measures, etc. A significant event in the history of domestic civil aviation was May 1, 1921, when the first regular mail-passenger airline was opened from Kharkiv, which was served by 5 Ilya Muromets aircraft.

Aircraft designers in Ukraine created new, safer aircraft. As a result of the increase in the production of aircraft of national design, primarily by designers K. Kalinin, V. Khioni, Y. Neman, V. Tairov and others, the process of ousting foreign airplanes took place. By the mid-1930s, their purchase was stopped. This was significantly facilitated by K. Kalinin's aircraft created from 1925 to 1938, from the K-1 to the K-23. Already in his first plane, the K-1, he proposed the concept and main schemes of its design, which at that time were significantly different from traditional ones. As the design of the plane, a winged plane with an original elliptical wing was chosen, this gave a number of advantages. The smallest losses on vortex formation, increased lateral stability, reduced engine energy, which ensured higher speed and longer flight range. It was a breakthrough in aircraft construction. The effectiveness of this form was theoretically substantiated by the famous German hydro-aerodynamicist L. Prandtl. K. Kalinin's priority in the development of the design of such a wing was confirmed by a patent in 1923. He used chain-mail aluminium as the main structural material for the first time. K. Kalinin began to implement the idea of unifying his own designs, which made it possible to reduce development costs, increase its reliability and manufacturability, and make it easier for pilots to master new equipment. At the first air show for Soviet aircraft manufacturers in Berlin (October 1928), the Kalinin "K-4" won the main prize - the Gold Medal. The reliability of the K-4 aircraft was proven by the event when, in August 1929, during an ultra-long flight on the Kharkiv-Moscow-Irkutsk-Moscow-Kharkiv route (it was in the air for 73 hours and covered 10,400 km), the engine failed on its final stage, but the plane in covered 100 km in gliding mode and successfully landed at the Kharkiv airfield [11]. A special place among K. Kalinin's planes belongs to the K-5 plane (1929), which became the flagship of passenger aviation and operated until 1940. His giant K-7 plane, work on which began as early as 1929, was one giant wing (area 454 square meters), but although he was not happy, he was several decades ahead of his time in terms of his technical solutions. On November 21, 1933, during one of the flights, one of the tail beams broke and the plane fell to the ground from a height of about 100 m and caught fire. There were 20 people on board, 15 of them died. The established state commission did not find errors in calculations and construction [6, 113].

In Ukraine in the 1930s, civil aviation also used aircraft of other designs - PS-9 (ANT-9), P-5, ANT-35, Li-2, "Stal-2", "Stal-3" , U-2, amphibian Sh-2, etc. The network of Ukrainian airlines, which in 1940 reached 27.5 thousand km, was constantly growing. In 1936–1940 alone, more than 109,000 passengers were transported by planes of the Ukrainian Civil Aviation Administration [6, p.96-97]. Training of aviation specialists was carried out in the newly established aviation institutions, in particular the Kharkiv (1930) and Kyiv (1933).

With the appearance of new types of aircraft in the 1930s, the requirements for airfields increased. The increase in the weight of aircraft required, for safety reasons, to limit the height of obstacles in the airfield areas during take-off and landing. Therefore, the requirements for the approach angle were increased from 1/15-1/25 to 1/70-1/80 [4, p.173].

In 1923, the Society of Aviation and Aeronautics of Ukraine and Crimea - was established, with G. Petrovskyi as the chairman of the Council. [3, p. 111].

In parallel with the Council of Civil Aviation, the Civil Air Fleet Inspection under the Chief Air Fleet operated, and in March 1923, the joint-stock company "Ukrpovitroshlyah" (UPSh) was established, which became the first civil aviation company of Ukraine (1923-1930). The first Kharkiv–Moscow, Kharkiv–Kyiv, Kharkiv–Simferopol, Kharkiv–Odesa airlines began to operate on the planes purchased abroad from the Dornier company. The first international air route in Ukraine was opened in February 1928 along the Kharkiv–Baku–Enzeli–Tehran route.

The adoption of two air codes in 1932 and 1935 was of great importance for aviation activity and ensuring flight safety. In addition to the adoption of the codes, this stage is marked by significant rule-making in terms of regulating the main issues of civil aviation. Among the adopted documents are the Temporary Disciplinary Statute of the Civil Air Fleet (1939), the orders: "On the categorical prohibition of overflight of the sanitary norm of flight hours by pilots of the civil air fleet" (1938), "On measures to combat accidents of the civil air fleet" (1940) and others. [5. with. 20].

In order to ensure the safety of civil aviation during this period, fairly high criteria were introduced for industry workers. In the first years of the formation of civil aviation in the Soviet republics, the main source of replenishment of its ranks with specialists of various specialties was military aviation, and the procedure for staffing was determined by a special instruction dated October 25, 1923. It provided for the selection of educated "military pilots" at the age from 21till 40 years old for the position of civil aviation pilot, who are in good health, have flown on airplanes for at least 300 hours, have excellent knowledge of aviation technology, etc. [12, p. 44].

In the 1930s, the first pneumatic-hydraulic autopilots of the first generation of the AVP series were created (autopilot AVP1 in 1932), which were significantly improved over time.

In the 1920s and 1930s, it was difficult to ensure the safety of flights and prevent disasters. This was due to the fact that the flights took place in rather difficult conditions, there were imperfect means of navigation and communication, the lack of meteorological support for flights, etc. Therefore, it can be stated that, for example, on May 19, 1926, a passenger plane crashed in Kharkiv, which collided with a wooden building during descent. 2 passengers died, the pilot, mechanic and 2 passengers were seriously injured [13].

1939 - 1945. From the beginning of the Second World War until the attack of Nazi Germany, the civil air fleet of Ukraine as part of Aeroflot continued to carry out its peaceful work, carried out the transportation of passengers, mail and cargo, improved its infrastructure, developed medical aviation, cultivated agricultural land, carried out the fight against forest pests, locusts, aerial photography, etc. After Western Ukraine joined the Ukrainian SSR in 1939, routes were laid from Kyiv to Lviv, Ternopil, Stanislav (Ivano-Frankivsk), Rivne, and Lutsk. In

September 1939, the board of the main administration of the civil air fleet approved the "method of high-altitude flights" (from 3.5 to 6 thousand m)), which, as it noted, was "a great contribution to the struggle for safety, regularity, high speed and economy of flights..." [12, p.93]. In connection with the threat of military aggression were trained 10,000 pilots for the Air Force [14, p.4].

During the years Ukrainian civil aviation acted heroically from the first days of the war. During the war, the front-line units of the Civil Air Fleet, along with victories, suffered significant losses - more than 1,000 aviators and more than 1,500 aircraft [4, p.253].

Since many aircraft were damaged during the war, in 1942 a Scientific and Experimental Base was created for the repair of material parts of the Air Force. At the same time, the repair and technological department of the research institute of the civil air fleet began to investigate the causes of aircraft accidents, which contributed to a certain extent to the increase of flight safety.

In 1944, the International Civil Aviation Organization (ICAO) was established, which established international standards for ensuring the safety, reliability and efficiency of air transport.

Already the first standards and recommendations of ICAO on the investigation of air incidents were adopted by the ICAO Council in April 1951 in Appendix 13 "Investigation of aviation accidents" to the Chicago Convention. [1].

The period from 1946 till 1990s is considered the prime time of domestic aviation, when the aviation industry was re-equipped, it began to occupy key positions at the republican, all-Union and international levels, and significant measures were taken to ensure flight safety. Airplanes with turboprop and turbojet engines appeared on the air routes of Ukraine - a line of OKB Antonov aircraft - from An-2 to An-124 "Ruslan" and An-225 "Mriya", airliners Tu-104, Tu-134, Tu-154, Yak-40, Yak-42, Il-18, Il-62, etc. Mi-2, Mi-6, Mi-8, Ka-26, etc. helicopters began to be operated intensively. Already in the 1960s, Ukrainian civil aviation took the first place in Aeroflot in terms of the number and length of air lines, the transportation of passengers, mail and cargo.

An important event for Ukraine was the accession of the USSR to the International Civil Aviation Organization (1970), which issued the first edition of the "Guidelines for the Prevention of Aviation Accidents" in 1984. In it, for the first time, the interaction of three groups of accident factors was considered: man, machine and the surrounding environment, and the "human factor" was recognized as a priority in the field of ensuring flight safety [8].

The improvement of the legal framework of flight safety is primarily associated with the adoption of the Air Codes of 1961 and 1983. They embodied all the main norms of air law, and most importantly, they increased the requirements for air transport and, first of all, in the matter of ensuring the safety and regularity of flights.

Ensuring the safety of civil aircraft flights is a complex problem that is solved by the joint efforts of all structures of the aviation and transport system. The first post-war decades were marked by a high level of accidents, when, according to ICAO, almost every thousandth flight in world aviation had serious safety problems, and among the main causes of events, the first place was occupied by the failure of aviation equipment [15, p.168].

In particular, the plane crash of the Il-18B passenger plane that occurred on August 17, 1960 in the Kyiv region (34 people died) was caused by a violation of the tightness of the fuel nozzle in engine No. 4, which resulted in a burnout of the combustion chamber and oil cavity casing, which led to a fire. According to the results of the investigation, the fire partitions of AI-20 turboprop engines were replaced with titanium ones, and the material of the pipelines was replaced from duralumin to steel, and the industry began to produce aircraft with the specified changes [16]. In the process of operation, the AI-20 engine of the designer O.I. Ivchenko reached an aircraft

engine resource unmatched by anyone anywhere in the world - 8,000 hours between repairs and 22,000 (!) hours in total [17].

In the 1950s and 1990s, the activities of workers in the aviation industry to modernize aviation equipment and ensure flight safety, minimize risks in aviation, because in this field it is still relevant to achieve a zero option for the elimination of aviation accidents. Innovative achievements of designers, scientists, engineers, and experts made it possible to reduce the probability of accidents in world aviation to one per 100,000 flights by the 1970s [15, p.169].

A significant role in ensuring flight safety was played by test pilots who "examined" new flying machines in various conditions and modes. Among the representatives of this dangerous profession, a special place belongs to the Hero of the Soviet Union Yu.V. Kurlin, Hero of Ukraine with Order No. 1 "Golden Star" O.V. Galunenko, his son test pilot E.O. Galunenko and others. In particular, Yu.V. Kurlin took part in the creation and testing of world-famous aircraft of the "An" family - An-2, An-8, An-10, An-12, An-14, , An-24, An-26, An -28, An-30 An-32, An-72, An-74, An-22 "Antey", An-124 "Ruslan", An-225 "Mriya". He made experimental landings with both engines stopped on An-24 and An-26; An-32 flights from high-altitude airfields in India; An-74 landings on frozen and wet runways; flights to study the behavior of the An-124 "Ruslan" in the wake of another aircraft and airdropping of heavy cargo; extinguishing fires on the An-32P in difficult conditions in Spain and Portugal, etc. [6, p. 203-204].

Test hero O.V. Galunenko set 263 world aviation records, including on giant aircraft An-124 "Ruslan" and An-225 "Mriya". His name is entered in the "Guinness Book of Records", and his activity was marked by the orders "For Merit", "Badge of Honor", "For Love and Faith to the Fatherland", "Equal-Apostolic Prince Volodymyr" [6, p. 308-309].

The flight practice of E.O. Galunenko includes mastering 20 types of aircraft. He, in addition to test flights, including in the conditions of the Far North, completed state test programs for obtaining the Certificate of Suitability of An-74 TK-200, An-38-100, An-140, An-148 aircraft, making dangerous flights at large "angles of attack" and system failures in flight, etc. [6, pp. 310, 312].

Scientists, engineers and technicians of the Kyiv Institute of Civil Aviation Engineers, the Kharkiv Aviation Institute, employees of the Central Research Institute of Central Asia, as well as military aviation specialists worked quite actively and fruitfully on the issues of ensuring flight safety. In the 1970s, 23 industry research laboratories operated only in Kyiv Institute of Civil Aviation (KIICA) [18, p.163].

During this period, the main scientific directions were formed at the Kharkiv Aviation Institute. On the basis of theoretical research, innovative structural and technological solutions for aircraft were developed by DKB Antonov O.K., Tupoleva A.M., Mikoyan A.I. The very concept of "constructive-technological solution", which reflects the essence of the development of parts and aggregates from composite materials, was first formulated in the works of the KHAI school and subsequently became generally accepted [19, c.99].

The mass use of gas turbine engines in civil aviation exacerbated the problem of ensuring the reliability and durability of aircraft engines. In this regard, a group of KIICA scientists under the leadership of Professor L.P. Lozytsky in the early 1960s created mathematical models of the operational behavior of structural elements, which became the basis for practical calculations of durability assessment, operational resources of a wide range of parts and programs equivalent to cyclic tests of engines. This prompted the leadership of the Ministry of Civil Aviation in the mid-70s to create a branch research laboratory at the institute for the further development of methods for diagnosing and managing the technical condition of aircraft engines [20, p.11].

Since 1955, professor T.M. Bashta began to deal with the fundamental problems of

industrial hydraulics and pneumatics at KIICA. Tower. Many innovative developments developed in the scientific laboratory created by him were put into practice. In particular, recommendations were developed for the transition to operation of the hydraulic equipment of the Tu-134A, Tu-154B, Yak-40, Yak-42 aircraft, and the developed tactical and technical requirements for hydraulic systems of supersonic aircraft were used in the creation of the Tu-144 supersonic aircraft [21, p.25]. Proposed and created for the first time in the world by T.Bashta, the system of automatic spin-up of the wheels of the landing gear in the air before the revolutions of the start of landing made it possible to avoid hydraulic shocks and yuzu of aircraft [Founder of Ukrainian hydraulics// Government courier.-2019, February 9]. 5 chief designers of aviation equipment and many scientists and specialists graduated from the scientific school of M. T. Bashta [20, p.25].

Research by a group of scientists of the problems of theoretical and applied aerodynamics (the founder of the direction is professor A.M. Mkhitaryan), in particular in the field of the theory of laminar and turbulent intermediate layers, semi-confined and immersed jets, was aimed at improving the take-off and landing characteristics and lightning protection of aircraft, increasing flight safety and environmental cleanliness. Their scientific achievements were taken into account in the practical activities of the aviation and other branches of the country. [20, p.19].

In order to increase the safety of aircraft flights in the 1970s, under the leadership of Professor V.O. Kasyanov, research on flight dynamics, flight simulation, and identification of flight models began. Representatives of other countries took part in the research alongside KIICA scientists [21, p.7].

The scientific researches of other leading scientists of KIICA - professors V.O.Ignatov, V.S.Novykov, A.O.Komarov, L.P.Lozytskyi, Zh.S.Chernenko, F.K.Hermanchuk and others contributed to ensuring aviation safety . They created new methods and optimal strategies for maintenance of aviation equipment "as is" on controlled An-24, Il-18, Yak-40 aircraft. In 1963, the first textbook for students "Technical operation of airplanes, helicopters and aircraft engines" was published (authors V.M. Suharnikov, F.K. Hermanchuk, G.N. Heletukha, M.F. Davidenko [20, p.9]

The problem of the failure of aircraft braking devices, which led to a significant number of aviation accidents, was solved by the participants of the scientific school for researching the state of friction materials and developing optimal methods of maintenance of aviation braking devices (founder F.K. Hermanchuk). The work of the scientists was implemented in the production of braking devices of all types of civil aviation aircraft and used during the development of the Buran program [21, p.7].

To increase the efficiency of operation of aviation radio-electronic equipment in the early 1960s, a branch research laboratory was created, in which, under the leadership of Professor L.Ya. Ilnytskyi and Associate Professor V.V. Kazimirchak developed a method of experimental operation of radio beacons of the short-range navigation system. Theoretical and experimental research, a significant part of which was carried out by Professor V.S. Novikov, encouraged the creation of a new progressive schedule-calendar system of operation. One of the important results of the scientists' research was the adoption in 1986 of the main regulatory and technological document "Guidelines for the technical exploitation of the means of radio-technical support of flights and telecommunications in civil aviation" using the new ICAO requirements [21, p.7,19].

In order to solve the problems of structural and parametric synthesis of radioelectronic systems, including of aircraft landing systems, professor V.P. Kharchenko proposed theoretical principles related to the functional description of dynamic systems. The properties of the ergative system "dispatcher-pilot-radiolocator" were

experimentally studied. The results of the research were widely used in the implementation of research and development works in the country [21, p.19].

Taking into account the statistics about a significant number of lightning strikes on planes in non-thunder clouds, the team of the department of aeronautical systems. In the 1980s, V.P. Kharchenko investigated the possibilities of finding zones of increased electrical activity in clouds that could not be considered as thunderstorms, and developed a complex active-passive method for remote detection of the electrical structure of cloud cover from an airplane [21, p.19].

The transition in civil aviation to the operation of multi-seater aircraft, a significant increase in their altitude and flight distance, the regularity of flights, flights in different climatic zones led to the actualization of the third group of emergency factors - the environment, which involved taking into account the impact of various adverse weather conditions on aircraft (icing, thunderstorms , torrential rainfall, wind shear, etc.). Considering this, professors V.O. Kasyanov, V.S. Maksimov, E.P. Udartsev and other KIICA scientists, thanks to experiments on the TAD-2, the largest direct-flow wind tunnel in Ukraine, began to study such risks for aviation, solved the problems of safe flight in conditions of wind shear and the influence of other external factors factors, optimal piloting, etc. [20, p.19; 21, p.14].

An important factor in increasing the regularity and safety of flights was the equipping of the main airports in the late 1960s with new SP-50 "Materik" landing guidance systems and the equipping of airfields with modern radio-technical means of navigation and landing [4, p.351,353].

The scientific group under the leadership of the head of the branch scientific research laboratory V.M. Sukharnikov for the first time considered the problem of the human factor in the maintenance of aircraft [21, p.6].

This problem appeared especially in the 1960s, when the "contribution" of human errors to aviation accidents was estimated at approximately 20%, and in the 1990s, this figure increased 4 times to 80% [8].

Despite carrying out significant work to ensure flight safety, flight accidents with serious consequences occurred in a number of units due to the fault of personnel. To overcome this, in 1971, the new "Instructions for Flight Performance in Civil Aviation", "Regulations on Assigning Classes and Issuing Certificates to Flight Crew of Civil Aviation" and others were put into effect. Measures aimed at increasing the efficiency of the use of aviation simulators were carried out. Work on the creation and improvement of flight simulators and simulators was started back in 1957 at the Kyiv Aviation Institute by Academician O.I. Kukhtenko, continued in the following decades [21, c.26].

In practice, emergency events did not stop, and in the early 1970s there was even an outbreak of them. After the crash of the An-10 passenger plane, the operation of this type of aircraft was stopped (except for transporters) [21]. The investigation of the flight events showed that the main reasons for the accident were insufficient preparation of crews for flights in difficult conditions, violation of flight rules, indiscipline of crew members and other aviation specialists, "fatigue" of metal, etc. It also became clear that the aviation equipment had begun to be inferior to foreign models in terms of its level and was often of low quality. Ten bulletins for their modifications followed the new aircraft leaving the industry (in 1973, there were 239 bulletins for the Tu-134, 174 for the Yak-40, and 629 for the An-24). During the same year, 75.2% of the prerequisites for flight accidents and incidents were registerd in the Ukrainian administration for technical reasons, 290 engines were removed ahead of schedule [4,p.366]. The issues of flight safety were presented at all levels - from the Management Board to the air squadrons, and the proposals of the airlines became the basis of the developed measures to ensure flight safety at each flight squadron. Also in 1973, the State Commission for the Safety of Civil Aviation Flights and the State Aviation Register - the

State Aviation Registrar were created under this commission. These bodies were entrusted with the supervision of ensuring the safety of civilian aircraft flights, the compliance of ships, airports, air routes and their regulatory actions with the norms, etc. [4, p.366].

Especially few measures to help flight crews have been established at airports developed by scientists for automatic landing of aircraft according to ICAO categories, since the biggest accident occurred during take-off and landing, when the time needed to make a decision was very small. The measures taken, including the adoption the new Disciplinary Statute of aviation employees, gave a certain positive result - in the mid-70s, the number of aviation accidents decreased by 1.5 times [4, p.377] .

Thus, in the 1950s and 1990s, during the unfolding of the global scientific and technological revolution, the civil aviation of Ukraine, having a powerful material and technical base, an appropriate regulatory and legal basis and highly qualified specialists, achieved significant success in its development, did a lot to ensure safety flights.

The modern stage of ensuring the safety of Ukrainian civil aviation flights begins on August 24, 1991, when the Act on the State Independence of Ukraine was adopted and which initiated a new, independent period in the development of domestic civil aviation. On September 9, 1992, Ukraine became the 172nd member state of the International Civil Aviation Organization (ICAO), then a member of the European Civil Aviation Conference (EECA), the European Organization for the Safety of Air Navigation (Eurocontrol), the World Federation of Unmanned Aviation (UAV), etc. The key direction was the global integration of civil aviation of Ukraine into the international aviation community, entry into the Common Aviation Area (CAA) with the European Union (EU). In sovereign Ukraine, the national system of state management of civil aviation, its infrastructure, the regulatory and legal system, etc., were consistently created. Thus, in 1992, the State Administration of Air Transport of Ukraine was created as part of the Ministry of Transport of Ukraine, in 1993 the Air Code of Ukraine was adopted, and in 2011 its new edition (with changes in 2012-2023), in 2009 the Concept was adopted The State Targeted Flight Safety Program for the period until 2015, a new version of the Law of Ukraine "On the State Program for Civil Aviation Safety" (2017), the Aviation Transport Strategy of Ukraine for the period until 2030 (approved in 2018), the State flight safety program (2021), which took into account ICAO, European Union, ECAC, Eurocontrol standards, as well as changes in the norms of Ukrainian legislation, etc. In the mentioned Law, it was noted that the main task of the Program is the distribution of responsibilities, establishing rules for the implementation and implementation of measures to ensure the aviation safety of passengers, aviation personnel and personnel involved in aviation activities, aircraft, property transported by aircraft, objects of aviation activity subjects regardless of the form of ownership and subordination. Since 2013, the activity of the National Bureau for the Investigation of Aviation Events and Incidents with Civil Aircraft (NBICA) has been introduced, which prepares conclusions and recommendations, summarizes data related to flight safety, etc. The Air Code of Ukraine states that flight safety is one of the components of the aviation safety system and gives an interpretation of the concept of "flight safety": it is "a state in which the risk of damage or injury is limited to an acceptable level." In addition, it stipulates that subjects of aviation activity, regardless of the form of ownership and subordination, must form aviation safety services [23, Art. 1.21, 85.6].

According to the Regulation on the State Aviation Service (2014), among its main tasks is the implementation of comprehensive measures to ensure flight safety, aviation, environmental, economic and information security. It also emphasizes that "the basis of flight safety management is a systematic approach to identifying and eliminating

sources of danger and implementing risk control to ensure flight safety in order to minimize human losses, material, financial, environmental and social losses" [24].

In the first years of Ukraine's independence, as a result of demonopolization of industry-wide and interregional structures, a significant number of small airlines emerged in the country (in 2001, there were about 100), whose fleet of aircraft sometimes did not exceed two or three machines. In the pursuit of profit, new air carriers often violated operational restrictions and deteriorated the quality of aircraft maintenance. All this led to a decrease in the level of flight safety and awareness of the need for appropriate reforms.

Solving the issue of updating the flight fleet, Ukraine continued to develop and create new aircraft - An-32P, An-38, An-70, An-140, An-148, An-158, An-178, An-132D, modifications of the An- 74TK-200, An-74TK-300, which met international requirements for the safety of aircraft operation, and also began to operate foreign liners of well-known airlines. In addition, the domestic aviation industry began to take part in cooperation with foreign partners to a greater extent. With the adoption in December 1996 of the Concept of Development of Civil Aviation of Ukraine, the second stage of development and formation of the aviation industry of Ukraine actually began. It is characterized by reforming and improving the system of state management of civil aviation, increasing measures to ensure flight safety, creating new national aviation legislation in accordance with international legal norms and rules.

After the establishment of the regional European Regional Center for Aviation Safety at NAU in 1996 by the decision of the ICAO Council, in 2002 the second such ICAO center was opened - for the training of state inspectors for flight safety and airworthiness of aircraft. The following year, in order to ensure the coordination of training and retraining of security specialists, the ICAO Institute was created at NAU. In modern conditions, the international aviation community (ICAO, IATA, Eurocontrol and other organizations) pays special attention to the "flight safety culture", the most influential components of which are organizational, professional and national cultures.). The "safety culture" is understood as the professional and psychological training of aviation personnel, the main purpose of which is the internal need to fulfill the established norms of aviation safety, which guarantees awareness of personal responsibility and self-control during work that affects flight safety]. In the ICAO Aviation Safety Management Manual (DOC 9859 AN-474), it is noted that the "human factor" is directly influenced by the working environment (right working environment) and a positive culture of flight safety [25].

In this regard, the Corporate Culture Procedure in the State Aviation Service of Ukraine was developed and approved (February 14, 2022 No. 1-560-22), as well as the Manual on the procedure for the adaptation of newly appointed employees of the State Aviation Service was approved (August 2, 2022 No. 1-1068- 22).

The decrease in the number of aviation accidents was not so fast, and their fate as a result of human error was increasing. If in 1996 it was 70-75%, then according to ICAO documents, 85% of air accidents are the result of the human factor [27, p.197].

However, increasing attention to safety in aviation gave positive results. In 2017, the world had the lowest number of plane crashes with victims, and in Ukraine, if in 2017 there were 5 crashes, 3 accidents, and 4 incidents, then in 2021, respectively: 2, 1, 2 [28].

In 2022, according to the information received by the NBICA from the subjects of aviation activity until February 24, 2022, there were 3 aviation incidents with Ukrainian-registered aircraft - two of which were in Ukraine and one incident outside its borders. All events occurred for different reasons, but, according to the authors of this analysis, the categories associated with the occurrence of aviation events remain unchanged over the years. These are aircraft rolling off the runway,

collision with obstacles during low altitude flight and failure or failure of power plant systems/components [29]. Among the important achievements of 2022 in the field of air transport of Ukraine was the adoption of the Law of February 17, 2022 No. 2067-IX, by which Ukraine ratified the Agreement with the European Union and its member states on the Common Aviation Area (CAA). In light of international incidents, such as the disappearance of Malaysia Airlines Flight MH370 Boeing 777-200ER on March 8, 2014, en route from Kuala Lumpur (Malaysia) to Beijing (China) over the South China Sea, ICAO implemented a new a standard requiring all commercial aircraft to report their location every 15 minutes to air traffic controllers regardless of origin. The regulation, introduced by the ICAO in 2016, initially did not extend to the installation of any new aviation equipment. The standard is part of the long-term plan of the Global Aviation Distress and Safety System (GADSS), which requires new aircraft to be equipped with data transmission systems that are in constant contact with air traffic controllers [30]. Even after the annexation of Crimea, Ukraine took measures to ensure the safety of flights over the Black Sea (the airspace over the Autonomous Republic of Crimea and its territorial waters was closed to aircraft flights). Thus, the European Aviation Safety Agency (EASA) published in 2020 the updated Flight Safety Information Bulletin EASA SIB 2015-16R3 (Safety Information Bulletin) regarding the safe use of 6 routes that do not affect the territory of the ARC (L851, M856, M860, M854, M435, M861) and which EASA recommended to airspace users to use for flight planning over the Black Sea, where responsibility for air traffic maintenance is delegated to Ukraine [31].

In Ukraine, work on scientific and technical support of flight safety continued, even with a decrease in funding for the aviation industry. For example, it turned out to be the second country in the world (the first was the USA), whose designers created a aircraft collision avoidance system SPZ-2000. This idea was implemented in 2003 by the Kyiv Research Institute "Buran", which develops avionics for civil and military transport aircraft. Without such equipment, starting from 2003, all aircraft flights were completely prohibited by ICAO decision [32].

The events of February 24, 2022 fundamentally changed Ukraine's aviation development strategy and caused the closure of airspace for civilian purposes for an indefinite period. Some air carriers managed to evacuate their fleet of aircraft abroad, while the fleet of other airlines was forcibly "landed", is in conservation according to the regulations in closed Ukrainian airports and is waiting for the resumption of flights. The state of war in Ukraine caused a change in the determining priorities and long-term plans for the development of aviation, the provisions of which were regulated by the Aviation Transport Strategy until 2030. In particular, a new classification of airports was formed according to the level of damage caused [35].

Ukrainian airports actively cooperate with the EU, studying the needs and expectations of carriers. According to the Aviation Committee of the Chamber of Commerce and Industry of Ukraine, there is a great demand from foreign airlines, which is confirmed by the fact that only 9 out of 63 airlines left BSP Ukraine. The activity of our airports at international events stimulates air carriers to plan their return to Ukraine [36]. In modern conditions, while a full-scale war is going on, civil aviation of Ukraine, as noted by the Deputy Prime Minister O. Kubrakov, is focused on three priorities: the preservation of highly qualified aviation personnel, maintenance of aviation infrastructure in proper condition and deregulation of the industry within the framework of the previously initiated reform [37].

The head of the State Aviation Service of Ukraine, O. Bilchuk, said that in order to ensure the protection of civil aviation, the territory of Ukraine and the airspace above it are classified as conflict zones with a high degree of risk to aviation safety by order of the State Aviation Service dated 04.07.2023 No.

438. This is due to the presence on the territory of Ukraine of real threats to aircraft and personnel of civilian airports/airfields caused by the full-scale military invasion on the territory of Ukraine (shelling of populated areas, destruction of civilian objects and critical infrastructure objects, etc.) [38]. A significant event for civil aviation was the adoption of the Law of Ukraine dated March 21, 2023 (No. 3007-IX) "On Amendments to Certain Legislative Acts of Ukraine for the Purpose of Development of General Purpose Aviation, Adaptation of Ukrainian Legislation to European Union Legislation in the Field of Civil Aviation, establishment of additional mechanisms for effective control over ensuring aviation safety and deregulation of economic activity in the field of civil aviation". The changes provided for in it are aimed at simplifying access to the markets of air transportation and ground handling services by adapting the legislation of Ukraine to the legislation of the European Union in this area, as well as enshrining at the legislative level additional measures to increase the level safety of aviation.

Conclusions. Thus, at all stages of the more than 100-year history of civil aviation of Ukraine, various measures were constantly taken to ensure aviation safety&security and minimize risks in aviation, especially since the second half of the 20th century. Innovative achievements of designers, scientists, engineers and technicians, training of highly qualified aviation specialists at the national and international level have become the achievement of global aviation. The integration of domestic aviation into the European and world community contributed to the strengthening of aviation safety&security in Ukraine.

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UDC 652.02: 656.078
DOI: https://doi.org/10.46783/smart-scm/2024-24-2
JEL Classification: R41, R42, R51.
Received: 15 February 2024

Savchenko L.V. PhD of Technical Sciences, Associate Professor, Associate Professor of Logistics Department of National Aviation University (Ukraine)

ORCID – 0000-0003-3581-6942
Researcher ID – Q-5323-2018
Scopus author id: – 57208225385

Semeriahina M.M. Senior Lecturer of Logistics Department of National Aviation University (Ukraine)

ORCID – 0000-0001-7490-6874
Researcher ID – S-7158-2018
Scopus author id: –

MODERN SUCCESSFUL GLOBAL SOLUTIONS IN ENVIRONMENTALLY FRIENDLY URBAN DELIVERY AND THEIR APPLICATION IN UKRAINE

Lidiia Savchenko, Myroslava Semeryagina. "Modern successful global solutions in environmentally friendly urban delivery and their application in Ukraine". *Nowadays the issue of reducing environmental pollution is on the agenda of all countries. Among the areas that have huge negative consequences for nature, logistics and supply chains take their place. Today, there are many concepts and scientific currents that recognize the need to account for the environmental component in urban logistics. Environmental aspects are used when evaluating the efficiency of investment projects, developing new models of vehicles, calculating taxes and insurance payments, and when searching for the best delivery schemes.*

The goal of the work. Taking into account the world experience in research on the chosen topic, the purpose of this study is to consolidate the world's successful experience in environmentally friendly urban delivery and assess their applicability in Ukraine.

Technologies and methods that allow reducing the negative impact of motor vehicles on the environment include:

The technology of off-peak delivery, which allows you to improve the speed mode of the car. With off-peak delivery, the probability of traffic jams is minimized, which makes the speed of movement the maximum permissible in the city (and, accordingly, the most environmentally friendly). Although night delivery is currently not possible in Ukraine due to the curfew, late and early delivery is still available, allowing you to successfully bypass traffic jams.

Use of consolidation centers. The economic idea of consolidation of freight transportation is to use the effect of scale - the greater the carrying capacity of the vehicle, the lower the specific costs for transportation of a unit of production. Currently, the construction of the consolidation center is being evaluated from the point of view of the impact of the supply chain on the environment. At the same time, the existence of a consolidation center near or within the city allows to organize delivery by vehicles with zero or low level of environmental pollution.

Use of Parcel Delivery Lockers. Delivery lockers are usually installed in places where the maximum flow of residents is concentrated, which makes it possible to create additional comfort for users due to the possibility of choosing the point closest to their own home or place of work. This method eliminates up to two thirds of harmful emissions into the air. The number of post machines and the area covered by them increases year by year, which allows us to talk about the success of this technology. According to the results of 2022, such major players of express delivery as "Nova Poshta" (now "Nova"), "Ukrposhta" and "Meest" will continue to work with post delivery lockers in Ukraine.

Use of more environmentally friendly types of transport. The use of hybrid, electric or non-motorized vehicles is increasingly used in last-mile logistics. Electric vehicles, mopeds, two- or three-wheeled bicycles with a large trunk or cargo body can be considered environmentally friendly types of urban logistics. Such vehicles have practically zero emissions of harmful substances, they are much more maneuverable and do not require a lot of space for unloading, loading and parking.

Implementation of zones with low (zero) air pollution. Zones with zero or low emissions have long been used in developed countries. There are no generally accepted technologies for calculating the territory that requires restrictions on the movement of transport, as well as for calculating the cost of such movement. Usually it depends on the will of the local authorities, the wishes of the residents and the well-being of the region.

Prohibition on the use of motor vehicles. Some local authorities introduce a complete ban on the use of motor vehicles within certain parts of the city. Usually these are historical centers with dense buildings and a large number of tourists. Sometimes such drastic measures are combined with night delivery technology. If this is not possible, the only alternative is delivery by small, usually two- or three-wheeled, zero-emission vehicles.

Improvement of traffic management. Competently designed organization of road traffic can reduce the pressure on the environment. The use of an intelligent transport system in smart cities allows you to perform important tasks like detection of transport accidents; automated control of the ramp, traffic lights and parking, etc. Improvement of road conditions. This refers to the quality of the road surface, markings, cleanliness of the road surface, etc. Improvement of road conditions indirectly affects the improvement of environment of the region.

Summing up the results of the research, successful global practices in environmental friendly urban logistics are highlighted, which are applied and have prospects for application in Ukraine. It was concluded that there is a huge potential of using world experience in urban logistics of Ukraine. This will bring Ukrainian logistics and urban supply chains to a new level, increasing the level of health and general satisfaction of the citizens.

***Keywords**:* last-mile logistics, urban (city) delivery, urban (city) logistics, environmental friendly delivery, parcel delivery lockers, low-emission (zero-emission) zones, environmental friendly vehicles, off-peak delivery, freight consolidation

Лідія Савченко, Мирослава Семерягіна. "Сучасні успішні світові рішення в екологічній міській доставці та їх застосування в Україні". *Зараз питання зниження забруднення навколишнього середовища стоїть на порядку денному всіх країн. Серед сфер, що мають величезні негативні наслідки для природи, займають своє місце логістика і ланцюги постачань. На сьогодні існує безліч концепцій та наукових течій, які визнають необхідність обліку екологічної складової у міській логістиці. Екологічні аспекти використовують і при оцінці ефективності інвестиційних проектів, і при розробці нових моделей транспортних засобів, і при розрахунках податків і страхових платежів, і при пошуку найкращих схем доставки.*

Мета роботи. Ураховуючи світовий досвід у дослідженнях з обраної тематики, метою цього дослідження є консолідація світового успішного досвіду в екологічній міській доставці та оцінка їхньої застосовності в Україні.

До технологій та методів, що дозволяють знизити негативний вплив автотранспорту на навколишнє середовище, належать:

Технология позапікової доставки, що дозволяє поліпшити швидкісний режим автомобіля. За позапікової доставки мінімізується ймовірність дорожніх заторів, що робить швидкість переміщення максимально допустимою у місті (і, відповідно, максимально екологічною). Хоча нічна доставка в даний момент в Україні неможлива через комендантську годину, пізня і рання доставка все ще доступна, що дозволяє вдало обійти транспортні затори.

Використання консолідаційних центрів. Економічна ідея консолідації вантажних перевезень полягає у використанні ефекту масштабу - чим більша вантажопідйомність транспортного засобу, тим менші питомі витрати на перевезення одиниці продукції. Наразі будівництво консолідаційного центру оцінюється і з погляду впливу ланцюга постачання на довкілля. При цьому існування консолідаційного центру біля або в межах міста дозволяє організувати доставку транспортними засобами з нульовим або низьким рівнем забруднення навколишнього середовища.

Використання поштоматів. Поштомати зазвичай установлюються в місцях зосередження максимального потоку мешканців, що дозволяє створити додатковий комфорт користувачам завдяки можливості вибору найближчого до власного будинку чи місця роботи пункту. Цей спосіб виключає до двох третин шкідливих викидів у повітря. Кількість поштоматів та зона покриття ними збільшується рік у рік, що дозволяє говорити про успішність цієї технології. За підсумками 2022 року, в Україні продовжують працювати з поштоматами такі великі гравці експрес-доставки як "Нова Пошта", "Укрпошта" та "Meest".

Використання більш екологічних видів транспорту. Використання гібридних, електричних чи безмоторних засобів пересування знаходить дедалі більшого застосування у логістиці останньої милі. Екологічними засобами міської логістики можна вважати електромобіль, мопед, дво- чи триколісні велосипеди з великим багажником або кузовом для вантажів. Такі транспортні засоби мають практично нульові викиди шкідливих речовин, вони набагато маневреніші і не вимагають великого місця при розвантаженні, навантаженні та паркуванні.

Впровадження зон із низьким (нульовим) забрудненням повітря. Зони з нульовими чи низькими викидами вже давно використовуються у розвинених країнах. Загальноприйнятих технологій розрахунку території, яка потребує обмежень на переміщення транспорту, а також розрахунку вартості такого переміщення не існують. Зазвичай це залежить від волі місцевої влади, бажань мешканців та добробуту регіону.

Заборона використання автотранспорту. Деякі місцеві влади запроваджують повну заборону використання автотранспорту в межах певних частин міста. Зазвичай це історичні центри із щільною забудовою та великою кількістю туристів. Іноді такі кардинальні заходи поєднуються із технологією нічної доставки. Якщо це неможливо, єдиною альтернативою залишається доставка малогабаритними, зазвичай двох-трьохколісними транспортними засобами з нульовими викидами.

Удосконалення організації дорожнього руху. Грамотно спроектована організація дорожнього руху здатна знизити навантаження на довкілля. Застосування інтелектуальної транспортної системи у розумних містах дозволяє виконувати важливі завдання: виявлення транспортних пригод; автоматизоване керування рампою, світлофорами та паркуванням тощо.

Поліпшення дорожніх умов. Мається на увазі якість дорожнього покриття, розмітки, ступінь чистоти дорожнього полотна і т.ін. Поліпшення дорожніх умов опосередковано впливає і на поліпшення екологічної чистоти регіону.

Підбиваючи підсумки дослідження, виділено успішні світові практики в екологічній міській логістиці, які застосовуються та мають перспективи застосування в Україні. Зроблено висновок, що існує величезний потенціал використання світового досвіду в екологічній міській логістиці

України. Це дозволить вивести українську логістику та міські ланцюги постачання на новий рівень, підвищуючи рівень здоров'я та загальної задоволеності населення.

Ключові слова: логістика останньої милі, міська доставка, міська логістика, екологічна доставка, поштомати, зони з низьким вмістом викидів, екологічні транспортні засоби, доставка у позапіковий час, консолідація вантажів

Introduction. Currently, the issue of reducing environmental pollution is on the agenda of all countries. Developed countries, which have significant funds on their balance sheets to prevent or combat pollution, have long invested money in scientific research and real projects that allow them to cause less harm to the environment, thereby increasing the standard of living of their citizens.

Literature review. Since environmental issues are now occupying many scientists around the world, a lot of research is being carried out in the field of environmentally friendly urban delivery. We can highlight the works of such authors as Taniguchi E., R.G. Thompson, T. Yamada, F. Russo, A. Comi, L. Persia, M. Holotová Holienčinová, L. Nagyová, G. Ambrosino, A. Liberato, I. Pettinelli, E. Cascetta, R. Filippova, N. Buchou, Boichuk N., Kauf S., Margita N.O., O. Lobashov, O. Kunitska, S. Gritsenko and others.

However, in most cases, foreign authors pay attention to solutions for their countries or cities, and research by Ukrainian authors concerns the adaptation of existing or the development of new concepts and technologies only for individual solutions in urban logistics.

Purpose of the study. Taking into account global experience in research on the chosen topic, the purpose of this study is to consolidate global successful experience in environmentally friendly urban delivery and assess their applicability in Ukraine.

Main part. Among the areas that have huge negative impacts on the environment are logistics and supply chains. Since the Industrial Revolution, when economic profit was the only measure of business efficiency, a huge number of concepts and scientific movements have appeared that recognize the need to take into account the environmental component in human activity [1]. As for transport, which is the largest polluting component in logistics, the situation is changing dramatically and quickly. If 50 years ago no one thought about calculating emissions from a vehicle, now this indicator is necessary [2, 3]. It is used when assessing the effectiveness of investment projects, developing new vehicle models, calculating taxes and insurance payments, and when searching for the best delivery schemes [4, 5, 6].

Technologies and methods that can reduce the negative impact of vehicles on the environment include:

- delivery during off-peak times (at night or on weekends);
- the use of consolidation centers at different levels (in the region, at the entrance to the city, in the city) [8];
- use of parcel delivery lockers;
- inclusion of more environmentally friendly types of transport (for example, electric transport, cycling) in last-mile delivery [9, 10];
- introduction of low (zero) emission zones in parts of the city [11];
- ban on the use of vehicles;
- improvement of traffic management;
- improvement of road conditions.

Below, the above-mentioned technologies are analyzed in more detail.

1. Off-peak delivery. Off-peak times in this case are usually considered to be either overnight delivery or delivery in the middle of the working day, which avoids morning and evening congestion in the city. The time used for this term may vary and basically depends on the business traditions of the region.

First, let's look at how off-peak delivery can have a positive impact on the environment relative to traditional delivery

during business hours. Under general equal conditions, delivery is considered more environmentally friendly if:

- fewer vehicles are used;
- the most environmentally friendly speed mode is used;
- more environmentally friendly vehicles are used.

Off-peak delivery technology makes it possible to improve the speed limit of the vehicle. This is achieved due to the fact that during delivery the probability of traffic congestion is minimized, which means that the speed of movement will be the highest possible in the city (the most environmentally beneficial). This should also include the number of accelerations, decelerations, stops and starts of the engine.

The denser the traffic flow, the slower the movement speed will be. At the same time, the driver has to constantly slow down and pick up speed, following the speed of traffic in a traffic jam. Such movement significantly increases fuel consumption and, accordingly, the amount of emissions.

In addition, congestion significantly increases the likelihood of an accident with minor damage to vehicles, which, however, block one or even several lanes, worsening the already difficult situation on the road [12].

Night delivery in Ukraine is currently not possible due to the strict time frame of the curfew. They are different in different cities, but actually make it impossible to use the night hours from 00:00 to 5 am. At the same time, late delivery and early delivery are still possible, which allows you to avoid traffic jams.

It should be added that night delivery is usually accompanied by increased noise levels, which negatively affects city residents at night. Using electric or two-wheels vehicles for last-mile logistics can significantly reduce noise pollution.

2. Use of consolidation centers

The idea of freight consolidation has been around for a long time. At that time, the main factor indicating its effectiveness was purely economic. It was based on economies of scale - the greater the carrying capacity of the vehicle, the lower the costs for transporting a unit of product. Unfortunately, often the economic effect was impossible due to the significant costs of the consolidation center itself, its maintenance and additional personnel in the supply chain.

Now the construction of the consolidation center is also being assessed from an environmental point of view [13]. If, in the process of consolidating deliveries, it is possible to reduce the number of vehicles involved in transportation, then this will also have a positive effect on the environment in the transportation area [14]. At the same time, the existence of a consolidation center near or within the city makes it possible to organize delivery to residents by vehicles with zero or low levels of pollution - bicycles, mopeds, electric cars, etc. [15].

3. Use of parcel delivery lockers

A popular alternative to home delivery is parcel lockers, known by several other terms such as parcel kiosks, locker boxes, automated lockers, self-service delivery lockers, and intelligent lockers [16]. Lockers are usually installed in places of concentration of the maximum flow of residents, which allows to create additional comfort for users due to the possibility of choosing the locker closest to the home or work area. It was established that this method saves up to two thirds of emissions [17]. The "last mile" problem using post machines is discussed in [18], modeling the use of storage cells for vehicle routing, taking into account CO_2 emissions, customer time window, and congestion.

The number of parcel lockers and the area covered by them increases from year to year, which speaks of the success of the technology. The idea is that part of the road in urban delivery falls on the client himself. In contrast to home delivery, the product is delivered to the locker by means of a postal or logistics operator, from where the customer picks it up.

At the same time, two types of post technologies should be distinguished: Pick-

Up and Drop-Off location (PUDO) and Automated Parcel Machine (APM). PUDOS are drop-off points where parcels can be picked up (for example, a small 24-hour shop, a parcel point or a depot/micro-depot). APM is a locker in its modern form. The statistics for 2022 differ significantly across European countries (Table 1).

Table 1 - Number of post offices and drop-off points in Europe in 2022

PUDO	APM
Germany 51090	Poland 28880
France 49200	**Ukraine 14000**
Italy 47740	UK 15460
UK 45340	Germany 13450
Poland 29520	France 8750
Ukraine - ?	Czech Republic 7480

Express parcels delivery overlap with other segments such as mail, pallet distribution, LTL, freight forwarding, same-day courier and contract logistics, so some of the lines are blurred. At the end of 2022, Nova Poshta (now Nova), Ukrposhta and Meest continued to operate [19].

4. Use more environmentally friendly types of transport

The use of electric or non-motorized vehicles is increasingly used in last mile logistics. Typically, such vehicles are compact and economical when transporting small amounts of cargo over short distances. These distances are usually calculated from the consolidation center to the store/company, from the distribution center to the client, from stores or food outlets to city residents, etc. The types of such environmentally friendly delivery vehicles are quite diverse. The most traditional types can be considered electric cars and mopeds. However, there are also more exotic means - two- or three-wheeled bicycles with a large trunk or body for cargo, as well as the use of animals (horses, donkeys, camels, etc.).

The benefits from an environmental point of view are undeniable. Such vehicles have virtually zero emissions of harmful substances. Among other things, they are much more maneuverable and do not require much space when unloading, loading and parking [20]. If we talk about two-wheeled vehicles, they can move between traffic lanes, which does not increase the congestion on the traffic flow and does not reduce the speed of movement. Moreover, when movement is prohibited in certain areas of the city, delivery by two-wheels types of transport usually remains the only alternative to delivery on foot. This makes it a choice for delivery in the center of some cities.

5. Introduction of low (zero) emission zones. Zero- or low-emission zones have long been used in developed countries. However, the details of this technology may vary. From a complete ban on the movement of cars with a traditional fuel system to charging a fee when driving through the zone or moving within its boundaries. Moreover, both the ban and the fee may depend on the time of movement (for example, at night or off-peak time - cheaper or free of charge).

There are no generally accepted technologies for calculating the territory that requires restrictions on the movement of vehicles, as well as calculating the cost of such movement. This usually depends on the will of local authorities, the wishes of residents and the well-being of the region.

If it is necessary to move to an area with low (zero) emission, the postal operator must assess the cost (and general possibility) of delivery by automobile. If motor transport is not allowed in the zone, you should look for alternative delivery schemes (for example, those discussed in paragraphs 2-4). If moving by road carries additional costs (in the form of tax or fee), then the logistics operator must evaluate various alternatives, for example,

road transport and delivery by tricycle, or through a distribution or consolidation center. Thus, the environmental component of transportation has already been directly transformed into an economic one, which usually facilitates the assessment of options.

Unfortunately, looking at the congestion rates in Kyiv since 2018, we can clearly see that the situation is getting worse every year. If in 2018 Kyiv was in 13th place in the world in terms of traffic congestion, then by 2021 the situation has worsened to a critical third place. At the same time, the time in congestion increased from 42% in 2018 to 56% in 2021 (Fig. 1).

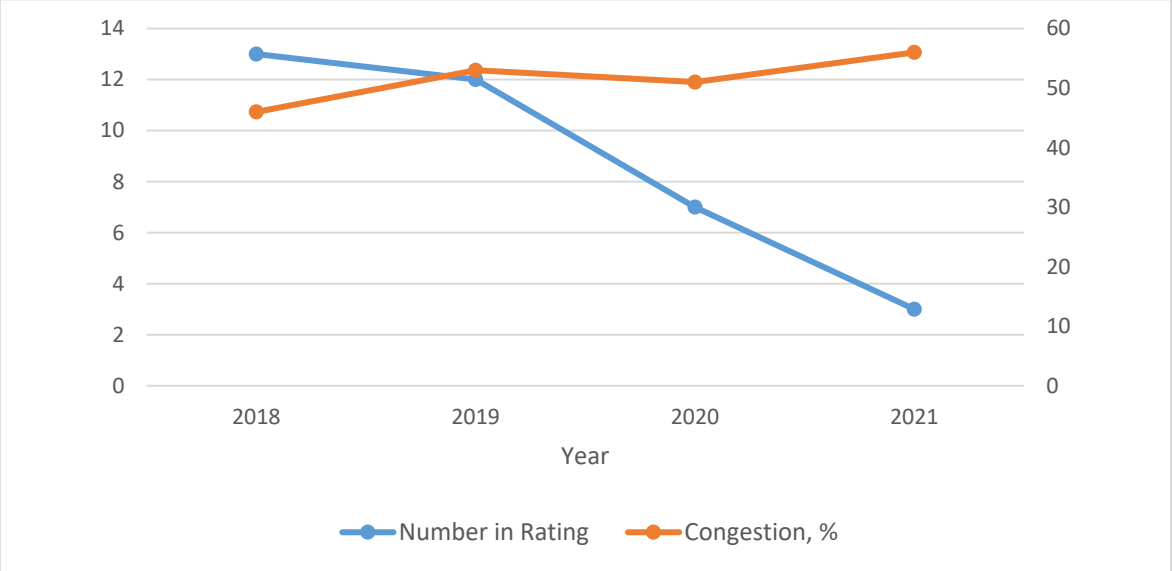

Figure 1 - Congestion indicators of Kyiv 2018-2021 [1]

Perhaps the congestion of traffic flows has decreased somewhat due to the war, however, sooner or later the war will end and the situation will return to its pre-war state, if it does not get worse.

Despite that, introducing the cost of entry to the central part of the city of Kyiv or other big Ukrainian cities is not currently on the agenda. The war, which is in its third year, does not allow investing in expensive long-term projects, even if they bring money at the stage of their implementation. The establishment of a fee for entering the zone involves the installation of a significant number of cameras, an information system capable of recognizing license plates, taking photos and videos, tracking violators, issuing invoices, etc. Given that the majority of budget funds currently go to the support of the Ukrainian Armed Forces, there will obviously not be any activities regarding the introduction of paid entry zones in the near future.

6. Prohibition on the use of motor vehicles

Some authorities have introduced a complete ban on the use of motor vehicles within certain parts of the city. Usually these are historical centers with dense buildings and a large number of tourists. Wanting to maintain the attractiveness of the area, the authorities are completely converting these zones into pedestrian zones. Exceptions are usually granted to police and emergency vehicles. As an alternative to motor transport, bicycle transport can be left, and sometimes even horse-drawn transport with strollers for tourists. Business restrictions associated with the ban are compensated by increasing the profitability of the tourism and entertainment business, while simultaneously improving the environmental situation in the city.

Sometimes such drastic measures are combined with night delivery technology, when the area is free of visitors. If this is not possible, the only alternative is delivery by small, usually two- or three-wheeled, zero-emission vehicles. For natural reasons, the technology of a complete ban on vehicle traffic is the most environmentally friendly, however, and the most challenging for business in this location.

Pedestrian zones are distinguished by a huge variety of attitudes and rules regarding vehicles using energy generated by human efforts: bicycles, roller skates, skateboards, scooters, etc. Main advantages:

– low amount of emissions into the atmosphere;

– low percentage of road accidents;

– better environmental conditions;

– encouraging people to an active lifestyle.

There are several pedestrian streets in Kyiv: Petro Sahaidachny Street (260 m), Andriyivsky Uzviz (650 m), Heroes of the Heavenly Hundred Alley (195 m), Bessarabsky Proyizd (130 m). Khreshchatyk Street (600 m) becomes a pedestrian street on weekends and holidays.

7. Improving traffic management

A well-designed traffic management can not only make life easier for the driver, but also reduce the burden on the environment. It is known that when accelerating and moving away, vehicle emissions are at their maximum. Stopping at traffic lights, allowing pedestrians to pass, frequent turns with a small radius - all this can significantly increase the pollution of both air, soil and groundwater in this region. Therefore, properly designed multi-level interchanges, underground passages, and tunnels can increase the speed for passing through a location, and also reduce the negative impact on the environment.

The use of an intelligent transport system in smart cities makes it possible to perform important tasks, which also lead to a reduction in environmental pollution:

1. Detection of traffic accidents.
2. Automated ramp control system.
3. Traffic light control.
4. Effective parking management tools.

The differentiated cost of parking encourages vehicle owners to travel through the central districts of Kyiv by transit, and if necessary, to park in more distant places (usually, near metro stations, etc.).

8. Improvement of road conditions

Under road conditions in this case, we mean the quality of the road surface, markings, cleanliness of the road surface, etc. If there are pits and potholes, the driver is forced to slow down and then pick up speed, which, as already mentioned, is associated with additional emissions of harmful substances into the atmosphere. In the case of poor-quality markings, a muddy or slippery road surface, the driver is forced to switch to a lower speed mode, which usually leads to large emissions as well.

As can be seen, the improvement of road conditions in this case indirectly affects the improvement of ecological cleanliness of the region.

Conclusions. Summing up the results of the study, it is necessary to highlight successful international practices in environmentally friendly urban logistics that are applied and have prospects for application in Ukraine (Table 1).

As we can see, there is huge potential in using global experience in environmentally friendly urban logistics. Of course, the prevailing challenge that does not allow us to begin its implementation in Ukraine is war. However, even in the pre-war period, little attention was paid to environmental problems, including urban ones, in comparison with developed countries.

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v.24 (2024)
https://smart-scm.org

Table 1 - Modern successful solutions in environmentally friendly urban delivery and their applicability in Ukraine

Global solutions in sustainable urban delivery	Current situation in cities of Ukraine	Prospects, recommendations for Ukrainian cities
Off-peak delivery	Limited use due to night curfew	Possible development after the war in combination with low-noise technologies and means of transportation
Consolidation centers	Poorly developed. Mostly distribution centers or logistics centers are used. However, there is no emphasis on cargo consolidation.	The authors consider it effective to build a network of consolidation centers (or use existing facilities) near large regional or industrial centers. For megacities - assessment of a micro-consolidation project within the city
Parcel lockers	Developed to a significant level. The Nova Poshta company brought Ukraine to 2nd place in terms of the number of parcel lockers in Europe.	Considering the good response from the citizens to the use of parcel lockers and their proven economic efficiency, it is recommended to stimulate the express delivery market to expand the parcel lockers network
Inclusion of environmentally friendly modes of transport in delivery	Poorly developed, mainly due to unfavorable weather conditions in winter. There is also a lack of interest from local authorities and motivation for business.	It is recommended to initiate a national program that clearly and significantly motivates businesses to switch to environmentally friendly types of transport within the city.
Low (zero) emission zones	Not used	It is recommended to conduct a feasibility assessment in the historical centers of large cities and with a clear economic justification for the amount of fees charged
Prohibition on the use of motor vehicles	Used in almost all regional cities and other tourist locations	A balanced approach is recommended, allowing not just a ban on cars, but a new concept for the functioning and development of the territory
Improving traffic management	Projects to improve traffic management are periodically created and implemented.	It is worth accelerating the processes of borrowing successful world practices in traffic management to reduce environmental pollution in places where cars accumulate
Improved road conditions	Overall, it is at an unsatisfactory level	Road conditions should be given constant and close attention, since the accident rate, the speed of delivery, and the amount of harmful emissions depend on them

We would like the good will of Ukrainian politicians and big business to turn towards perceiving our world not from a purely economic, but also from a social and environmental perspective. This will take Ukrainian logistics and urban supply chains to a new level, increasing the level of health and overall satisfaction of the population. The Ukrainian scientific community is ready to contribute to this task.

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The electronic scientifically and practical journal
"INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT",
ISSN 2708-3195

35-42
v.24 (2024)
https://smart-scm.org

UDC 658.7:159.9
DOI: https://doi.org/10.46783/smart-scm/2024-24-3
JEL Classification: D11, D81, L90, M14.
Received: 19 February 2024

Shchekhovska L.M. Senior Lecturer of Logistics Department of National Aviation University (Ukraine)

ORCID – 0000–0002–6119–166X
Researcher ID – GXG-7221-2022
Scopus author id: –

INTERACTION BETWEEN AUTOMATION AND HUMANS IN SUPPLY CHAIN PLANNING

Larysa Shchekhovska. «Interaction Between Automation and Humans in Supply Chain Planning». *Automation is transforming supply chain planning (SCP) processes, replacing human tasks with technological solutions. While automation offers efficiency gains, the interaction between humans and automated systems presents behavioral challenges. This study investigates how decision-makers in SCP processes learn to correct errors when interacting with automated demand forecasting systems versus human planners.*

Drawing from psychology and behavioral theories, we examine the effects of interaction type (automated system vs. human) on learning, operationalized as performance improvement over time. Further, we analyze whether this relationship is moderated by cognitive psychological traits (positive attitude towards technology, technology anxiety/dependence) and socio-psychological traits (social influence based on subjective norms, social influence based on image) of the human decision-maker.

Our article contributes to supply chain management research by introducing automation-human interaction, providing a temporal learning perspective on performance, and integrating cognitive and socio-psychological moderators. Insights are offered on how to facilitate effective human-automation collaboration by managing socio-psychological influences. Limitations and future research opportunities, including cultural contexts and artificial intelligence, are discussed.

Keywords*:* supply chain planning, automation, human-automation interaction, decision-making, learning, behavioral operations, cognitive psychology, social psychology, technology acceptance, demand forecasting

Лариса Щеховська. «Особливості взаємодії людини і автоматизованих систем під час планування ланцюгів постачання». *Автоматизація трансформує процеси планування ланцюгів постачання (SCP), замінюючи традиційне виконання технологічними рішеннями. Хоча автоматизація забезпечує підвищення ефективності, взаємодія між людьми та автоматизованими системами створює поведінкові проблеми. У цьому дослідженні досліджується, як особи, які приймають рішення в процесах SCP, вчаться виправляти помилки під час взаємодії з автоматизованими системами прогнозування попиту і людини.*

Спираючись на психологію та поведінкові теорії, ми досліджуємо вплив типу взаємодії (автоматизована система проти людини) на навчання, реалізований як покращення продуктивності з часом. Далі ми аналізуємо, чи модерується цей зв'язок когнітивними психологічними рисами (позитивне ставлення до технологій, тривога/залежність від технологій) і

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соціально-психологічними рисами (соціальний вплив, заснований на суб'єктивних нормах, соціальний вплив, заснований на іміджі) особи, яка приймає рішення.

Ця стаття сприяє дослідженню управління ланцюгами постачання, запроваджуючи автоматизовану взаємодію з людиною, надаючи часову перспективу навчання продуктивності та інтегруючи когнітивні та соціально-психологічні модератори. Пропонується уявлення про те, як сприяти ефективній співпраці людини та автоматизації шляхом управління соціально-психологічними впливами. Обговорюються обмеження та майбутні дослідницькі можливості, зокрема, культурні контексти та штучний інтелект.

Ключові слова: планування ланцюга постачання, автоматизація, взаємодія людини та автоматизації, прийняття рішень, навчання, поведінкові операції, когнітивна психологія, соціальна психологія, прийняття технології, прогнозування попиту

Introduction. The ongoing digital transformation with its technological advancements has an immense impact on future supply chains. One element connected to these technological advancements in SCM is automation, the replacement of existing resources, also regarding tasks performed by humans, through technology, which is expected to lead to considerable performance improvements for supply chain planning (SCP) processes.

Nevertheless, automation of processes comes with behavioral challenges in the interaction between automation and humans, especially because automation itself is imperfect and not always reliable. Hence, also innovative automation approaches in SCP, such as automated demand forecasting systems, are not free of editors, and have inherent limitations, especially if not all information is known a priori. In this context it must be noted that SCP processes, which aim at aligning the demand side with the operations capacity, are decomposed and carried out across different departments and human decision-makers.

Therefore, despite all technological advancements, human decision-makers will not become less important as intuition, trust and experience are expected to remain key competences [5]. Yet, it remains unclear how humans correct automated demand forecasts, and Fawcett and Waller ask whether "managers have the emotional fortitude to make and stick to decisions based on the analytics - even if/when they do not fully comprehend why"[7].

Analysis of recent researches and publications. The interaction between automation and humans in supply chain planning has been a topic of significant research and discussion in recent years. As automation technologies continue to advance, their integration into supply chain processes has become increasingly prevalent. However, finding the right balance between automation and human involvement remains a crucial challenge. These authors represent a diverse range of perspectives and research focuses within the broader topic of automation-human interaction in supply chain planning: N. Sanders, R. Basole, M. Bourlakis, M. Gerschberger, Yi. Zhang, H. Lee.

The purpose and objectives of the study. The study aims to provide insights into how automation-human interaction in SCP processes influences learning behavior, and how various psychological factors related to the human decision-maker affect this learning process. The objective is to understand the behavioral implications of introducing automated demand forecasting systems in supply chain planning from a cognitive and socio-psychological perspective.

Basic material and results. The literature does not offer a consensus on how to study SCP process performance. While some studies have focused on quantity-based ordering patterns, or the squared difference between actual and forecasted values, most studies have focused on the financial impact

in terms of profit and loss. The latter approach is particularly managerial relevant and will therefore also be used in this study. Additionally, we extend this approach by the perspective of temporal development [4].

Quantifying the temporal development of profit allows for analyzing whether the decision maker improves in his decision-making behavior while experiencing errors in the automated demand forecasts. This cognitive process can be coined as a form of learning, as psychology defines learning as a sustained change in behavior related to experiences. Notably, the central element of learning in this regard is not only the mere change of behavior, but a change of cognitive capacity, related to gaining new insights from experience, which in this case would enable to conduct improved forecast connections. In the case of this study, the change in cognitive capacity stems from double-loop learning, a specific type of learning, that relies on detecting errors and according correction. Similarly, in the context of the automation literature, learning is referred to as integration, which is "a process that occurs as a result of experiencing automation errors or failures". Combining these views, we define learning as the change of profit over time as a result of error detection through the decision maker, which in the context of our research is the production planner.

Turning to the behavioral outcomes, we introduce three different decision strategies (Fig.1) in the context of the initial described newsvendor setting within which the production planner interacts with the demand planner. All three strategies differ in the expected SCP process performance, with the third one being in the center of interest of this study. Before learning occurs, the simplest decision strategy would be to decide based (1) on the newsvendor properties while neglecting any other information such as demand history or supplied forecast. Compared to this strategy, still in the absence of learning, performance can be increased by (2) a strategy that considers both the newsvendor properties and the provided demand forecast [6]. The provided forecast entails both random error components and systematic error components to simulate the imperfect nature of automation. Therefore, an even better solution could be reached by (3) not only incorporating the demand forecast, but critically reflecting the demand forecast against the actually realized demand of the past periods to identify and additionally incorporate (part of) the systematic forecast error in the decision about future production quantities. Ultimately, this learning behavior enables the production planner to adjust the forecast in order to actively increase the SCP process performance.

In a decision task related to production quantities, as the one viewed in this study, from a behavioral perspective, the performance improvements induced through forecast corrections of the production planner depend on two mental processes. First, on incorporating the information provided by the demand planner to make decisions, and second, on critically reflecting the information in order to identify systematic error patterns in the forecast in order to improve decisions over time. As such, the behavior in question in this study is linked to two behavioral aspects: (1) incorporating the demand forecast, and (2) critically reflecting the demand forecast against the actual demand in order to identify systematic forecasting errors [1].

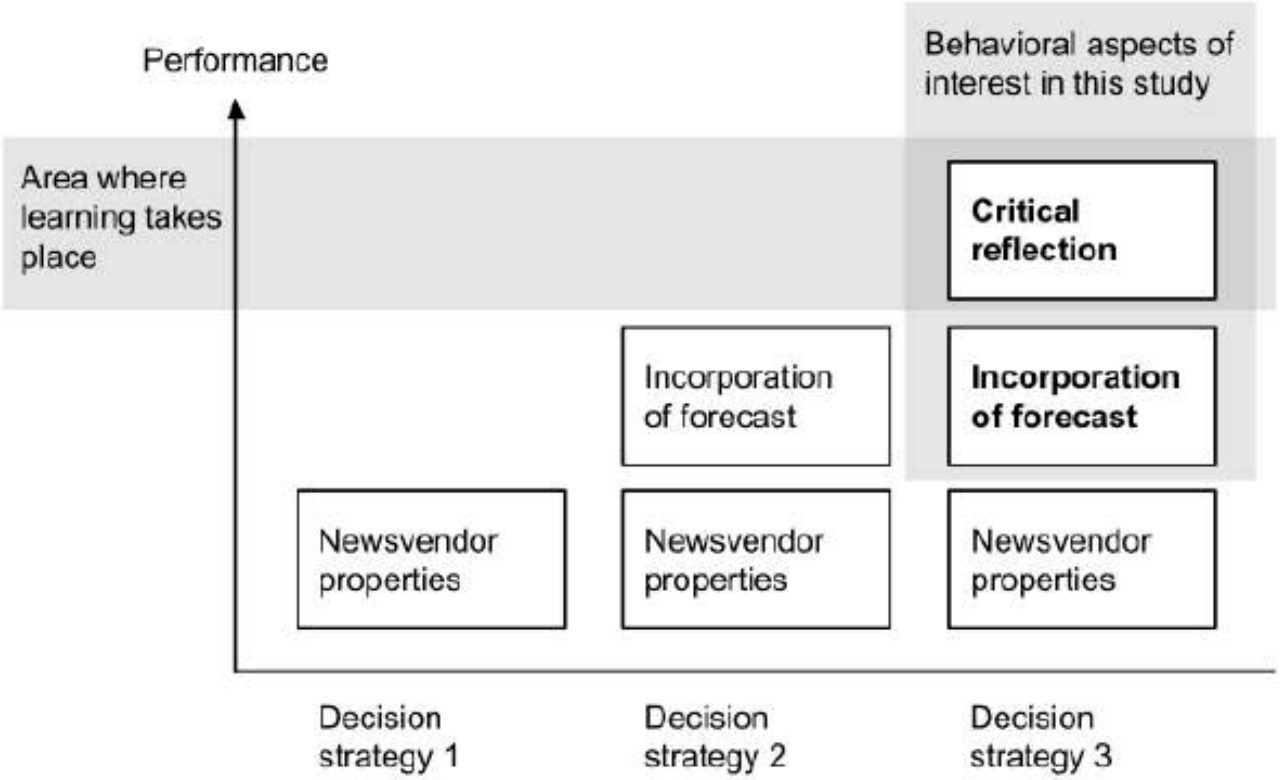

Figure 1 – Decision strategies and behavioral aspects
Source: developed by the authors

The main rationale behind this study is the assumption that a production planner's reaction to demand forecasts will differ depending on whether the forecasts are generated by a human or an automated forecasting system. This effect is thought to be moderated by psychological factors related to the production planner. For instance, an individual who feels pressured by norms to increase usage of new technologies may be less inclined to critically evaluate and fully engage with the automated demand forecasting system's projections. Consequently, when receiving automated demand forecasts, someone experiencing strong social pressure to utilize the automated system would exhibit smaller performance-improving forecast adjustments compared to someone facing little or no such normative pressure. In essence, the perceived source of the forecast (human vs. automated) and the individual's psychological orientation towards technology adoption norms are hypothesized to interact and influence how productively they incorporate the forecasts into planning.

The behavior of the production planner is, according to corresponding theories, the result of different cognitive and socio-psychological factors, where the former relates to factors "within the mind" of the decision-maker and the latter to the relationships of the person to other persons or groups. Moreover, according to the theory of planned behavior and the unified theory of acceptance and use of technology (UTAUT), behavior depends on the behavioral intention to perform the behavior in question, which in tum depends on various factors [2].

Our research will argue that the use and critical reflection of demand forecasts that stem from an automated demand forecasting system, as compared to those stemming from a human demand planner, will depend on different factors related to the production planner's relationship to technology. As such, the concepts derived from the theory of planned behavior and from UTAUT serve as

moderators. The former theory, in combination with the technology adoption literature, emphasizes that the attitude towards the behavior and the corresponding personal beliefs are highly relevant within the cognitive psychological domain. Here, Rosen offers a set of comprehensive concepts that reflect the attitude towards technology, of which the two most central and relevant concepts are positive attitude towards technology (PATT) and technology anxiety / dependence (TAD). PATT is defined as a general positive opinion about technology, including "the importance of keeping up with technology trends, the assertion that with technology anything is possible, getting more accomplished with technology, and the belief that technology will provide solutions to many of our problems". PATT has been extensively studied with regard to various technologies from different areas. The area of application of the concept of PATT ranges from electronic communication channels via nuclear power to heart transplants. In contrast to PATT, TAD reflects situations where persons feel dependent on technology so that an anxiety arises of being without technology, such as a smartphone or the internet. In this regard, dependence on technology means that the individual would find it difficult to refrain from its usage [10].

Complementing these two cognitive psychological factors, the second theory, UTAUT, offers an extensive view on socio-psychological factors that impact behavior. From these, we draw on social influence based on subjective norms (SISN) and on social influence based on image (SII). SISN is one of the most central and well-established constructs regarding the use of technology and was already proposed as part of the theory of planned behavior, and has been applied and refined extensively over time. It puts normative expectations of other persons in the focus and is defined as "the person's perception that most people who are important to him think he should or should not perform the behavior in question".

SII, in contrast, puts the self-image into the focus. This concept originally builds on Moore and Benbasat who extended the view on social influence by rooting the social influence not in the norms and expectations of others, but rather in the image that can be built via usage of technology. SII is defined as "the degree to which use of an innovation is perceived to enhance one's image or status in one's social system" [8].

Given the wide range of potential individual behaviors and preferences, it can be concluded that for some production planners, an automated demand forecasting system may be preferable, while for others, a human demand planner may be more favorable. Therefore, we conclude that neither setup is inherently better: The type of interaction (automated demand forecasting system versus human demand planner) does not significantly impact learning outcomes.

In other words, there is no one-size-fits-all solution that is universally superior. The appropriateness of using an automated system versus a human planner depends on the specific behaviors and preferences of the individual production planner. Ultimately, the learning process is not significantly affected by whether the demand forecast comes from an automated system or a human expert.

Positive attitude towards technology is an important driver of successful implementation of new technologies as profound empirical evidence exists for the Linkage between attitude towards technology, employee's intention to use new technology, and eventually the actual usage of these technologies. Additional evidence for the link between behavioral intention and actual behavior can also be found in the theory of planned behavior. That means strong PATT, with people exhibiting a favorable attitude towards the technology in question, leads to technology being used more widely and effectively. Thus, stronger PATT would also lead to a stronger incorporation of the forecast into the decision-making process of the production planner. However, learning over time

additionally requires critical reflection of the demand forecasts in order to allow the decision-maker to identify systematic errors in the forecast, regarding how much the forecast deviates and in which direction the forecast deviates. Here, the effect of PATT requires a differentiated discussion. A non-positive attitude may result in outright rejection of the automated demand forecasting system. Evidence for such an effect can be found in previous studies that have outlined the importance of strong PATT for successful acceptance of technology and consequently engagement with the technology. Therefore, with low PATT no engagement with the system may occur, not even a critical one [7].

On the contrary, decision-makers with an absence of positive attitude might be more critical towards the automated demand forecasting system and may therefore also spend more effort in identifying its potential shortcomings.

Decision-makers that exhibit high TAD feel dependent on technology, so that anxiety arises towards being without technology, and, per definition, find it difficult to refrain from using available technology [3]. Here, dependence implies that a decision-maker will incorporate forecasts supplied by an automated system into his decision-making. However, in contrast to the above situation of a strong PATT, high TAD makes persons overly dependent on technology, to a degree where the technology usage can have severe negative implications [4]. The reason for this is an increased level of techno stress in people with high TAD. Techno stress is an established theoretical concept, that has first been introduced by Brod and was since then steadily extended and refined. It comprises "any negative impact on attitudes, thoughts, behaviors, or body psychology caused directly or indirectly by technology" [6]. Highly relevant to this study is the observation by Wang who note that techno stress in individuals, for example provoked through technology dependence, may inhibit further learning. With this concept in mind, we argue that high TAD and the resulting techno stress are contrary to freedom of mind and critical thinking, which is why the production planner will follow the automated demand forecast more closely, leading to a stronger incorporation of the forecast into the decision, with the final decision value of the production planner being closer to the suggested forecast as compared to people with lower TAD. This also implies an under-reliance on one's own capabilities and over-reliance on technology, reducing the ability to use one's own judgement required to identify error patterns in the automated demand forecasts. Following the above lines of argumentation, decision-makers with high TAD, because of their psychological dependence, find it difficult to refrain from its usage. They are characterized by a compulsive use of technology that hampers critical reflection of the automated demand forecasting system and the forecasts it supplies. Therefore, decision-makers faced with an automated demand forecasting system will learn the less, the stronger their TAD is [5].

A decision-maker who experiences strong social influence based on subjective norms (SISN) to use new technology will, according to UTAUT have a stronger intention to actually use this technology. Venkatesh argues that in a mandatory setting, where only the new technology is available for use and no other alternative, social influence as a socio¬psychological factor has a positive effect on the decision-maker's intention to use the technology. Therefore, high SISN leads to a stronger incorporation of the forecast into the decision-making process of the production planner. The underlying mechanism is a compliance effect, which is particularly pronounced in the early phase of technology usage before usage is habituated. However, according to the theory of planned behavior, norms can be understood as a "social pressure to perform or not to perform" a certain behavior. This is consistent with the argumentation that SISN leads to compliance, and complying is fundamentally different

from the critical reflection necessary to identify error patterns in the forecast. One source provides substantial evidence by arguing that people might deviate from norms and act contradictory over time, which aligns with a certain theory that states the effect of "normative pressure will diminish as time passes." Additionally, according to another perspective, purely extrinsic stimuli and motivation imposed through normative expectations have a "negative effect on complex, mentally-engaging tasks, such as critical thinking". Consequently, strong social-institutional subject norms (SISN) hinder critical reflection and learning when a decision-maker is confronted with an automated demand forecasting system. In essence, the evidence suggests that over time, people may break from normative pressures. Moreover, externally imposed norms can negatively impact complex cognitive tasks like critical analysis. Therefore, strong institutional norms demanding technology usage can impair a decision-maker's ability to critically evaluate and learn from an automated forecasting system.

For SII and its effect on the usage of technology, we also draw on UTAUT but then extend this view by further arguments regarding its effect on learning. With regard to learning, SII differs from SISN as there is no social pressure present that stems from normative expectations. Instead, the social influence in this case is due to the prospect of improving one's own image when using new technology. According to UTAUT, the effect of SII is analogues to SISN regarding the mere usage of technology, but we argue that SII differs in its effect on the way technology is actually used. The reason for this is the absence of impeding factors hampering the cognitive process of critical reflection, while instead a more appealing motivation is evoked through SII. Seeing the prospect of enhancing one's own image as a much more positive stimulus with a desirable outcome lets us argue that a decision-maker with strong SII is much more motivated intrinsically. Here, Rogers states that "one motivation for many individuals to adopt an innovation is the desire to gain social status" [10]. Furthermore, recent research provides evidence for reciprocal behavior driven by positive feedback. Studies have shown that positive recognition has a favorable impact on people's willingness to put in effort, as well as their attitudes. Therefore, it is argued that the positive recognition effect likely acts as a strong motivator not only to use a technology but also to engage in related mentally-challenging tasks. In this case, to critically evaluate the system's forecast in order to leverage opportunities for enhancing one's image beyond merely using the technology, through improved usage performance. Consequently, individuals with a higher degree of self-image motivation and a resulting higher drive to engage in image-building tasks are more likely to exhibit learning behavior. In essence, positive feedback and recognition can motivate people to put in more cognitive effort, not just use a technology superficially. The desire to build a positive self-image acts as an incentive to critically analyze automated forecasts and learn how to utilize the technology more effectively, not just passively use it. Those highly motivated by self-image considerations tend to demonstrate more active learning behaviors.

Conclusions. As outlined, research on automation-human interaction in SCM is scarce, particularly from the behavioral research perspective. This is remarkable as automation and its interface with human actors plays an important role in many other areas of life such as "aircraft and air traffic control, nuclear power, manufacturing plants, military systems, homes, and hospitals" [1]. Given this importance, we argue that also SCM needs to quickly catch up and advance in the understanding of automation-human interaction while integrating the behavioral perspective. This is particularly relevant as it is argued that human interaction will still be in necessary in the future, even if we advance to more sophisticated technologies such as artificial intelligence applications. By studying

the impact of automation-human interaction on learning in supply chain planning (SCP) processes, and by discussing related theoretical concepts and developing and applying an experimental research design, this study contributes on both the theoretical and the managerial level.

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UDC 334.752
DOI: https://doi.org/10.46783/smart-scm/2024-24-4
JEL Classification: H54, L52, L32, L33.
Received: 2 March 2024

Guluzadeh Elmir. Deputy Director of Heydar Aliyev International Airport National Aviation Academy (Azerbaijan)

ORCID – 0009-0008-0206-3431
Researcher ID –
Scopus author id: –

PRIVATIZATION OF AIRPORTS AND MODEL OF PUBLIC-PRIVATE COOPERATION

Guluzade Elmir. "Privatization of airports and model of public-private cooperation". *This article provides a comprehensive analysis of public-private cooperation at airports, delving into several key aspects of this partnership model. It examines privatization models implemented in various countries globally, shedding light on the diverse approaches adopted in different regions. Additionally, the article offers insights into the intricacies of public-private collaboration, using airports as a prime example. By exploring the nuances of such partnerships, it aims to uncover the underlying mechanisms that drive successful cooperation between governmental bodies and private entities within the aviation sector.*

Keywords*:* supply chain planning, automation, human-automation interaction, decision-making, learning, behavioral operations, cognitive psychology, social psychology, technology acceptance, demand forecasting

Гулузаде Ельмір. "Приватизація аеропортів та моделі державно-приватного партнерства". *Ця стаття містить комплексний аналіз державно-приватного партнерства в аеропортах, заглиблюючись у кілька ключових аспектів цієї моделі партнерства. У статті розглядаються моделі приватизації, які реалізуються в різних країнах у всьому світі, проливаючи світло на різноманітні підходи, прийняті в різних регіонах. Крім того, стаття пропонує розуміння тонкощів державно-приватного партнерства, використовуючи аеропорти як яскравий приклад. Досліджуючи нюанси такого партнерства, стаття має на меті виявити механізми, що лежать в основі успішної співпраці між державними органами та приватними структурами в авіаційному секторі.*

Ключові слова: аеропорт, приватизація, модель державно-приватного співробітництва, цивільна авіація, економіка

Introduction. The concept of privatization has been on the global agenda since the 1980s. This concept is mainly an economic approach promoted by international financial institutions. Privatization is also a political concept. The concept was first used by Peter F. Drucker in the form of the term "reprivatization" in his book The Age of Discounting, published in 1969. The concept of privatization in politics was first used in the Conservative Party election process in England during the presidency of Margaret Thatcher (Bryan, 1988: 1; Surel, 1999: 445). But what is privatization? Privatization can be understood as the individualization or sale of movable and

immovable property owned by the state through auctions.

The concept of privatization can be the object of study of some sciences, such as economics, business management, law and political sciences (Aktan, 2010: 102). Analyzing the tasks and functions of privatization, we see that there are studies that define it as the partial or complete transfer of an institution or organization from the public sector to the private sector (Avgustyniak, 2010: 36; ACRP, 2012: 1; Graham). , 2017: 143). Some studies define privatization as the sale of some or all government assets to the private sector (Ramamoorthy, 1992: 225). According to other writers on privatization, "privatization is the transfer of productive assets to the private sector" (Parker and Kirkpatrick 2003: 50).

Privatization can be classified both broadly and narrowly. In a relatively narrow context, privatization is the partial or complete transfer of state-owned economic enterprises, public assets, shares and services to the private sector (Giray, 2003: 38). The staff turnover rate must be at least 51% (Aktan, 2010: 101). In a broad sense, privatization is defined as any measure that leads to an increase in the role of the private sector in the economy (Eker, 1995: 82; Ozkan, 2008: 16).

The concept of privatization refers to four different processes and operations (Falai, 1993: 188);

1. Privatization of financing of goods and services produced by the public sector.

2. Privatization of the production of goods and services financed by the public sector.

3. Partial or complete transfer of ownership and management of state-owned enterprises to the private sector.

4. Elimination of the previous state monopoly in the production of goods and services in the public sector.

In a practice similar to privatization in history, the Romans are known to have owned privately financed roads, ports and postal services (KÖl, 2019: 9). In recent history it has been reported that if royal lands in Europe were sold, privately owned lands would be improved and cultivated within a few years (Smith, 1776: 824). If we look at the history of public investments made in connection with private sector financing, the privatization of London Bridges, the Brooklyn Bridge and the French Canal project can be seen as one of the first steps taken in this area (Yescombe, 2007:5). The practice of privatization in its current sense began in Chile in the 1970s (Akdemir, 2008: 321).

The privatization movement is a radical process that began in the UK in 1982 with the sale of 51% of British Telecom (IATA, 2005: 11). Thanks to the Thatcher government's privatization program, the public sector's share of the economy fell by more than 50% (Kabaklarli, 2008: 44). The first step in the field of privatization in France was taken in March 1986 by Jacques Chirac. State-owned enterprises must be assessed by an independent commission and closed at a certain price. Thus, the number of privatized organizations in France reached 22, and all these processes were privatized for 12 billion dollars in 15 months (Ozkan, 2008: 16).

The Czech Republic is one of the countries that has a successful privatization policy. In a short time, the process was completed by distributing shares worth $5.5 billion to the population using the coupon method (Kabaklarlı, 2008: 56).

Privatization goals. Looking at the research and academic studies on privatization, it is clear that the objectives of privatization are grouped into three groups: economic, social and political. For privatization to be successful, independent economic mechanisms, reliable contracts and control mechanisms are necessary. For privatization to be successful, public support is necessary (Mahmood and Kau, 1992: 43). Although privatization requires a service quality contract to provide quality and low-cost services, government officials must be experienced enough to supervise the business and determine the price, and government participation as a regulator in

privatization activities will result in government participation as regulator in privatization activities. interests. The independence of the economic regulator is the most appropriate way. Although economic regulation is effective in extracting maximum benefit from existing assets, it can limit new investment (IATA. 2005: 37).

Disadvantages of Privatization

Privatization is a balanced process. Of course, privatization is expected to increase efficiency, employment and income, but the desired results may not always be achieved. For example, according to studies covering the years 1984–2004 in Turkey, despite the jobs created by privatization, the number of workers who lost their jobs as a result of privatization is considered high (Yasar 2006: 127). . Countries with poorly developed capital markets earn less than developed countries (Ozcan, 2008: 49).

The main disadvantages of privatization (IATA, 2005):

- Preparation and implementation of privatization is a long and expensive process (Yashar 2006: 3).
- The contract should be studied and drafted very carefully.
- Services transferred through privatization may have high prices and low quality.
- If government assets are leased, they can be returned to a low-tech, outdated state.
- An object leased as part of privatization cannot be managed by government agencies that have not worked for a long time after being returned to the state.
- Governments obtain loans at lower interest rates than private loans.
- Objections to privatization, especially in developing countries (Mahmood and Kau, 1992: 37):
- Workers may fear losing their jobs, bureaucrats may fear losing their boss titles, and politicians may be accused of selling off government property.
- Governments tend to sell off unprofitable companies. The private sector is seeking to create commercial organizations.
- Companies that are able to buy large state-owned enterprises will have difficulty raising the necessary capital.
- Dismissal of employees and increase in jobs during the privatization of some organizations
- As a result of privatization through the distribution of shares to employees, it will be difficult to manage the institution.

Airport ownership, airport ownership and operation. Let us turn to data on airport privatization, analyzing the transition from the traditional way of operating airports to a commercially oriented one. Traditionally, the most common airport operating models have been government ownership and operation. According to ICAO, public administration and airport management are divided into two types. It is operated directly by government or commercial civil aviation organizations (ICAO, 2013: 2-1). The operational structure of public airports around the world is typically shaped in three different ways. These (Kuyuchak, 2007: 24);

- Central government ownership and operation
- State and commercially oriented state corporation.
- Ownership and operation of regional management.

The management style of regional airports is generally applicable to US airports. In this model, the airport is managed by the local government. In Europe, Manchester Airport is 55% controlled by the city council, while in Germany Düsseldorf is owned by regional states. Some airports are under joint local and central management. Frankfurt Airport is controlled 45% by local government and 26% by central government. Amsterdam was 76% owned by the local government and 22% owned by Amsterdam (Graham, 2014: 8-9).

Until the 1970s, investment and operation of airports was carried out by

central government almost everywhere in the world, but in many countries, including England and Canada, applications for PPPs involving private investors in financing investment and operation of airports have come to the fore. etc., because (Uzunkaya, 2008: 25-28). Because airports require large investments and are sometimes used for military purposes, they have traditionally been government owned. As political reasons point to the development of existing cities, small airports have been established in many cities, albeit at a loss. Today, 78% of European airports are still publicly managed (ACI, 2016: 1). Governments can manage airports within a ministry, by creating a public airport management enterprise or jointly with another organization. In addition, non-commercial airport operations such as education can also be carried out.

According to TR.P, there are 4 types of airport management (ACRP, 2012: 12).

1. State ownership and management
2. State ownership of some operations
3. Public-private partnership
4. Private ownership and management

Researchers have identified that there are six different types of airport management and ownership models (Oum et al., 2006: 111);

1. Governance of the state directly or through a subordinate department.
2. High share of private sector PPP
3. State PPP with a high share
4. Public administration, private administration.
5. Joint management of public institutions (federal-local)
6. 100% state control

There are 8 different airport ownership and management models around the world (Lai, 2013: 43).

1. Government ownership and management (Finland and some US airports).
2. Public-private partnership with a larger share than private (Denmark, Austria and Switzerland)
3. Public-private cooperation has a large share of government (Hamburg, France, China and Kansai-Japan).
4. Long-term lease of airports, government ownership (Chile, Hamilton and some US airports).
5. Multiple government systems (some UK airports).
6. 100% government owned and operated (Singapore, Hong Kong and Taiwan).
7. Completely private (UAE).
8. Independent non-profit organization (Canada)

According to ACI, airport ownership takes the form of full private ownership, public-private partnerships and full government management (ACI, 2016).

Transition to privatization and commercialization of airports. Kuyucak and Wasig define airport privatization as "the transfer of any risks, responsibilities and profits arising from the provision of airport services from the public sector to the private sector for a specified period or on a permanent basis" (Kuyucak and Wasig, 2011: 2). The term "privatization" only applies to airports that are not exempt from government goods and services.

By definition, commercialization; This is the incorporation of commercial goals and objectives into the management approach of public enterprises (Humphreys 1999). At airports, the private sector can be found in various areas other than privatization (ACRP. 2012: 10). For the first time, cafes and airport parking were run by the private sector. Today, ground handling, housekeeping, ticketing, baggage handling and terminal commercial operations are largely handled by the private sector. By some estimates, 90% of US airport workers are private sector employees. The remaining 10% belongs to public organizations such as traffic management, customs, aviation administration (Lai, 2013: 45). According to ICAO, private participation at an airport can be divided into 4 parts; A management contract is the sale of partial ownership, ownership and management of an activity to the private sector (ICAO, 2013).

Private companies operate airports (ACRP, 2012: 11). Typically, loading, maintenance, bridges, baggage devices, escalators, elevators, moving walkways, etc. are used for They work in their fields.

- They perform ground handling.
- They take care of cleaning.
- They handle service and passenger parking and transport passengers to the airport.
- Food and retail professionals become terminal salespeople.
- Fuel companies supply fuel to airplanes.
- Consulting services cover the planning, design, construction and management stages.
- Investment and commercial banks can provide large amounts of capital.
- Can provide aircraft maintenance and catering services.

Although airport privatization is generally viewed as the transfer of airport assets or operations to the private sector, the private sector can take partial responsibility for and manage airports. The private sector may own some assets (ACRP, 2012: 9). In some countries, such as Canada (1996) and New Zealand (1987), widely available government air traffic control systems have been privatized. Air transport in the UK is operated by a semi-private company (Cruz and Marques; 2011: 392).

Aviation privatization in Turkey was first carried out in 1989, when a "package sale" of 70% of the catering company Uçak Servis A.Ş was carried out. 60% of the shares of Havaalanari Yer Hizmetleri A.Ş.(HAVAŞ) were privatized in 1995, and the remaining 40% in 1998 through the sale of stakes. Thus, the state is responsible for both airline food and ground transportation.

In 1987, the Canadian government proposed transferring airports to local governments. Although several cities, such as Calgary and Vancouver, were transferred to local governments, the central government continued to operate the remaining 130 airports (Doganis, 1992: 11). By the 2000s, more than 100 airports had been transferred to local authorities (Graham, 2014: 10). Airport relocation is a global practice. In 2005, 12 domestic airports in France were transferred to new owners in a privatization process (Graham, 2014: 9). This method is an approach that is first created as a joint stock company and then applied to privatization. Copenhagen Airport (1991), South African Airports (1994) and finally Narita Airport (2004) became joint stock companies before privatization.

What happened in the development of airports is described below (Graham, 2014: 6).

1. Commercialization of airports. Airports are transforming from transport infrastructure to commercial enterprises and adopting more commercially oriented practices.

2. Privatization of the airport. This transfer can be accomplished through share transfers, strategic collaborations and special management agreements.

3. Diversification of airport ownership. Previously, it was all about ownership and diversification of government-controlled airport investors.

Commercialization in public enterprises is the shaping of the management approach in public enterprises according to commercial goals and objectives (Humphreys, 1999: 122). Airport commercialization refers to the transformation of publicly owned and operated airports into a commercial, business-oriented management approach where commercial goals and objectives are defined (Ösenen and Şengür, 2016: 62). Commercialization plays an important role in covering airport costs by promoting the sale of cheaper tickets. Thanks to commercialization, Frankfurt Airport grew by 63% between 1976 and 1987 and its revenues by 283% (Doganis, 1992: 113). According to Advani's (1998) study of 201 airports around the world, the commercial activities of airports are not related to their ownership. (Halpern, 2006: 61).

Airport privatization. Privatizing an airport means privatizing management and operation. Airport privatization is considered to be the private sector taking over various tasks at the airport (ACRP, 2012). The transfer of air or ground infrastructure to the private sector is essential for the development of airport privatization. Private sector participation in airport operations means that the private sector plays a role in owning, controlling or managing the operation of the airport, while the majority or ultimate ownership remains with the government (ICAO, 2013). The term "airport privatization" is a concept associated with cooperation and commercialization (Augustyniak, 2010: 36). Leases of 20 years or more are generally preferred (DB 2011a: 18). Although "privatization" was previously the preferred term for airports, today the term "public-private partnership" is considered preferred for privatization-like applications other than sales to the private sector. In this regard, the terms privatization and PPP are used interchangeably for airports.

The first major privatization of an airport in the UK occurred in 1987 with the transfer of shares to the UAE. 3 airports in London (Heathrow, Gatwick and Stansted) and 5 airports in Scotland (Aberdeen, Edinburgh, Glasgow and Prestwick) were privatized. Jeremy Marshall stated in 1988 that the purpose of UAE privatization was profit (Doganis, 1992: 32). Following these successful privatizations, many airports were privatized (Augustyniak, 2009: 61; Graham, 2014: 13). No US airport has ever been sold privately. The private sector appears to bear the brunt of most US airport operations (WB, 2017: 148).

Reasons for airport privatization. The main objectives of airport privatization are to attract private capital, commercialization and operational efficiency (Graham, 2014: 33; In et al., 2017: 217; IATA, 2018b: 19). According to ICAO, factors that encourage the public to open airports to private companies include more efficient operations, ease of financial burden and reduced costs (ICAO, 2013). According to IATA, privatization aims to improve commercial and operational efficiency and the effectiveness of capital projects (IATA, 2018b: 7-8). Airports are expensive infrastructure. According to CAPA 2019, $245 billion in capital is needed for new airports worldwide, and $845 billion for renovation and expansion of existing airports (CAPA 2019). According to LATA, $1.2-1.5 trillion is expected to be spent on global airport infrastructure development by 2030. According to Eurocontrol research, in Europe, 108 airports serve 83% of the total number of passengers.

Only 17% plan to increase capacity by 2030 (Graham and Morrell, 2017: 10). According to the World Bank, there are 5 main advantages for the public sector in airport privatization (WB 2015b);

1. Avoids high construction costs.
2. It generates income
3. Transfers operational risks to private parties.
4. At the end of the contract, the airport's assets are returned to the public.
5. Private capital has been attracted to the airport.
6. The efficiency of the airport is increased.
7. According to a World Bank study, airports are important to the private sector for five reasons (WB 2015b);
8. Cash flow and profit expectations based on projected growth,
9. Airports generate significant foreign exchange income,
10. Commercial income,
11. Ensuring financial performance by increasing efficiency,
12. Opportunities for real estate development, commercial and ancillary activities outside the area covered by airport pricing rules.

Airport privatization has 6 main objectives (Graham and Morrell, 2017: 144);

1. Increase efficiency and productivity
2. Issue of new investment funds

3. Improving the quality of management and promoting diversification.

4. Improving the quality of service

5. Generate financial income for the public sector

6. Reduce your utility impact

7 airport privatization objectives have been identified (Rihi, 2014: 301);

1. Improve traffic and respond to traffic changes.

2. Ensuring wider economic development,

3. Get cash income,

4. Financing large-scale airport infrastructure;

5. Risk reduction,

6. Transfer of technology and experience,

7. Increased efficiency.

While the government expects operational efficiency and capital from the private sector, the private sector seeks to maximize profits by doing business for the benefit of society (In et al. 201 7: 2 I 7).

It demonstrates greater cash flow from its properties and greater growth potential (In et al., 2017: 218). When privatizing an airport, there is usually an interest in privatizing the terminal. This is both the more profitable and less regulated part. On the other hand, Airside is not an option for the private sector due to strict regulations, tight controls and tariff controls, and low income potential. (Cruz 2017: 198).

Commercialized airports focus more on revenue generation and cost reduction (EU, 2016). Airports managed by the private sector are more responsive to growth needs (In et al., 2017: 218). A critical factor in the success of airport privatization is accurate forecasting of airport passenger traffic, as well as revenues and expenses. Risks of privatization of a private airport: Incorrect calculation of passengers and costs, changes in legal regulation. Risks for the population include inadequate infrastructure and monopolization of services (Augustyniak, 2010: 40-42).

The following are 10 important points for successful airport privatization (IATA, 2005: 5);

1. In a successful airport privatization, customers must be considered key stakeholders from the outset. The master plan, financial plan and economic arrangements must be developed in accordance with a transparent and agreed process.

2. Better management is key to successful privatization because the cost of capital in the private sector is almost always high.

3. Good governance is more important for public welfare than privatization. Excessive government intervention in the operation of leased (concession) airports leads to undesirable results.

4. Independent, sound economic regulation provides incentives to improve efficiency and distribute the benefits of privatization. Government remaining the regulator of the economy leads to vested interests.

5. Economic regulatory legal acts are subject to verification by an independent competition commission.

6. Although economic regulation is useful for maximizing profits from existing businesses, it can be prohibitively expensive for new investments.

7. Adjusting the consumer price index (CPI-X) price cap can help improve efficiency. ROR, on the other hand, can lead to inefficiency and monopoly profits in the early stages of airport privatization.

8. For cost-effective and high-quality service, it is necessary to conclude an agreement on the quality of services.

9. Undervaluation of assets increases both aviation and non-aviation costs. This puts additional pressure on airlines. To avoid this, checks should be carried out and monolingual counting should begin.

10. Private sector participation will provide the desired benefits to the user. Jewelers' opinions are important.

Information sharing is critical in airport privatization (U.S. Government Accountability

Office, 2014; In et al., 2017: 217). Under the UK Airports Act 1986, airports are subject to stricter accounting rules than usual (Doganis, 1992: 30). The government's priority in privatization is to protect public interests and interests (In et al., 2017: 218).

Airport privatization: expectations, benefits, advantages. Benefits of airport privatization: promoting competition; ensuring timely delivery of projects, increasing efficiency (thus reducing costs for end users) and reducing political/administrative interference in the commercial management of airports (Cruz and Sarmento, 2017: 198). Another study indicated the following potential benefits from privatization (ICAO, 2013: 2-4);

a. Revenues from the use of airport resources are used for the transparent operation and development of facilities;

b. Costs are paid directly from money collected from passengers;

c. Reduces the financial burden of governments;

d. The private sector calculates income and expenses better and makes decisions faster. Improves airport efficiency and service quality,

e. The private sector can provide financing from various sources that the public sector cannot use;

f. Clearer separation of private sector operations and activities.

While the Vinci group was a regional airport operator until 2012, the 11 small airports had 8.5 million passengers and €150 million in revenue (Cruz and Sannento, 2017: 202). Looking at the group's 2018 performance, 240 million passengers generated $1.6 billion in revenue. In 7 years, revenues increased by almost 1000%, and the number of passengers increased by 3000% (Vinci 2019).

After moving production to Lisbon, Portugal, the company achieved high growth rates (Cruz and Sarmento, 2017: 202). According to the World Bank, what society expects from privatization is: shifting construction costs to the private sector, increasing revenues, shifting operation and maintenance costs to the private sector, repossession at the end of the operation, budget savings, and increased efficiency. To monitor them, key success indicators should be identified. According to the World Bank, private sector benefits from privatization include: rapid airport development, freedom from foreign exchange risk due to foreign exchange earnings, high income potential and income from business opportunities due to unregulated commercial income (WB 2015a).

Conclusions. In this paper we aim to show the significant impact of privatization in the field of civil aviation, especially in airport management. Here, of course, it is determined that privatization has both advantages and disadvantages. But in any case, the use of privatization in airport management is widespread in world experience. At the same time, the importance of the public-private cooperation model, which is one of the important tools of privatization, was especially noted. At present, of course, the mutual responsibilities, obligations and responsibilities of the state and the private sector must be clearly defined. In conclusion, in our subjective opinion, it is advisable to use a public-private model for the privatization of airport management.

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UDC 338.47
DOI: https://doi.org/10.46783/smart-scm/2024-24-5
JEL Classification: M21, M11, L21.
Received: 7 March 2024

Mirzayev F. M. PhD in Economics, Associate professor National Aviation Academy (Azerbaijan)

ORCID – 0009-0003-7097-6041
Researcher ID – JOZ-8255-2023
Scopus author id: –

Ahmadova G. T. PhD in Economics, Associate professor National Aviation Academy (Azerbaijan)

ORCID – 0000-0003-0821-7098
Researcher ID – KHZ-5825-2024
Scopus author id: –

Dadashova K. K. PhD student National Aviation Academy (Azerbaijan)

ORCID – 0009-0009-4144-914X
Researcher ID – JRX-0731-2023
Scopus author id: –

Bugayko D.O. Doctor of Science (Economics), Professor (Full), Corresponding Member of the Academy of Economic Sciences of Ukraine, Vice - Director of ES International Cooperation and Education Institute, Instructor of ICAO Institute, Professor of the Logistics Department National Aviation University (Ukraine)

ORCID – 0000-0002-3240-2501
Researcher ID – ABF-5564-2021
Scopus author id: – 57216582348

CLUSTER MARKET OF CIVIL AVIATION TRAINING COMPLEX SERVICES

Fuad Mirzayev, Gulnara Ahmadova, Kovsar Dadashova, Dmytro Bugayko. "Cluster market of civil aviation training complex services". *Classification and features of the educational services market are of interest due to the commercialisation of education and the widespread increase in the level of requirements for staff qualification. Vocational education represents a special segment of this market. The market of professional education of aviation specialists is an important and dynamically developing segment of the educational industry that can offer promising opportunities for training and career development in aviation. According to many researchers, the special importance of this element of the educational services market structure should be based on the integration of joint efforts of corporate training centres, industry agencies and the government with the needs of customers and industry standards. Personnel training itself is a complex multi-disciplinary system. Based on the research in the field of professional education of aviation specialists, the authors define the market of civil aviation simulator complexes services, characterise the market products and*

identify other features of the market and propose the concept of "cluster market of aviation simulator complexes services".

***Keywords**:* flight training center; cluster market; civil aviation training; simulator; professional training

Фуад Мірзоєв, Гульнара Ахмадова, Кевсар Дадашова, Дмитро Бугайко. "Кластерний ринок комплексних послуг з підготовки фахівців цивільної авіації". *Класифікація та особливості ринку освітніх послуг становлять інтерес у зв'язку з комерціалізацією освіти та підвищення рівня вимог до кваліфікації персоналу. На цьому ринку особливий сегмент представляє професійнаа освіта. Ринок професійної освіти авіаційних фахівців є важливим сегментом освітньої індустрії, що динамічно розвивається. Він здатний запропонувати перспективні можливості для навчання і кар'єрного зростання у сфері авіації. На думку багатьох дослідників, особливе значення цього елемента структури ринку освітніх послуг має базуватися на інтеграції спільних зусиль корпоративних навчальних центрів, галузевих відомств та держави з потребами клієнтів та галузевими стандартами. Сама підготовка кадрів є складною багатопрофільною системою. На основі досліджень у галузі професійної освіти авіаційних фахівців авторами дано визначення ринку послуг тренажерних комплексів цивільної авіації, проаналізовано характеристики продукції ринку, виявлено інші його особливості та запропоновано поняття «кластерний ринок послуг авіаційних тренажерних комплексів».*

Ключові слова: льотний навчальний центр; кластерний ринок; підготовка у цивільній авіації; тренажер; професійна підготовка

Introduction. The air transport system involves a wide range of stakeholders with diverse functional backgrounds, including international organizations, aviation authorities, operators, infrastructure companies, and others. The civil aviation industry operates air transport in its commercial activities. Its economic entities are linked by the goal of supplying safe and quality products to the air transport market. The aviation industry is presently recuperating from the Covid-19 pandemic crisis, following the guidelines of international civil aviation organizations. In order to improve management, it is recommended that the existing problems be addressed and that new forms of interaction and management be established for both the training and flight safety improvement segments. International civil aviation organizations encourage States to priorities the improvement of aviation training as part of national education policies and to actively participate in the development of the civil aviation workforce.

Numerous professionals are involved in guaranteeing the most crucial aspect of the system: the safety of civil aviation. Flight personnel have received special attention among aviation professionals, experts, and researchers.

Boeing reports that the global pilot training market was valued at $8.09 billion in 2023 and is projected to reach $20.02 billion by 2030, with a CAGR of 13.8% during the forecast period. In 2022 and 2023, the European pilot training market was valued at $2.02 billion and $2.31 billion, respectively. (Boeing, 2023)

However, although the pandemic has caused a reduction in the number of active pilots due to the inability of simulator training in the remote training format for aviation personnel, it is expected that over the next 20 years, the global commercial fleet will require 649,000 new pilots, 690,000 new maintenance technicians, and 938,000 new crew members. (Boeing, 2023)

The aviation industry worldwide is grappling with a shortage of pilots, which is

affecting numerous airlines and aviation businesses. The shortage of pilots is mainly caused by the retirement of a significant number of ageing pilots. The civil aviation personnel training system does not fully meet the needs of air transport organizations for qualified personnel. Experts and researchers pay special attention to targeted personnel training to meet industry needs which is ensuring the successful system functioning.

Aviation simulator complexes as the subjects of the educational services market. Currently, personnel training in civil aviation aims to achieve high labor results, reduce airline costs for additional training of young specialists and personnel retraining, and stimulate the growth of aviation training complexes (ATC).

Establishing new simulator training centers is easier than opening new flight training schools. Flight training schools require their own airfields away from major air transport centers, airspace for training flights, and instructors who meet strict health, age and skill requirements. Therefore, simulator training centers are a more practical option. Simulator training centers are typically located near airports, making them convenient for current pilots. This is in contrast to flight schools. Training centers may recruit retired pilots who have retired from flying due to age or medical reasons, but who have a wealth of professional experience and can provide valuable insight and knowledge to trainee pilots as instructors. Undoubtedly, initial pilot training requires both flight schools and simulator training centers. The following definition of an aviation training complex is considered appropriate on the basis of the above characteristics:

The Aviation Training Complex (ATC) is a civil aviation company dedicated to developing and maintaining the professional knowledge, skills and abilities of aviation personnel through the usage of an interactive flight simulator system.

ATCs provides theoretical and practical retraining for flight and technical personnel of civil aviation companies and offers comprehensive services in that field. Their technical facilities, training and education programmes enable the airlines-owners to provide airlines' personnel with such a range of services, as well as to provide these services to other air carriers on a commercial basis. As previously mentioned, the material and technical infrastructure of ATC represents a significant expense, which may not be feasible for all airlines. Analyzing the simulator base of the global civil aviation industry, we find a limited number of enterprises such as ATC, and fierce competition in the oligopolistic market of aviation simulator manufacturers. Due these reasons outsourcing is a prevalent practice in the provision of simulator training services.

All stakeholders in civil aviation, including international organizations, aviation authorities, operators, and other interested parties, should collaborate to create new forms of cooperation that benefit everyone involved in the development of the flight training and simulation market. The education sector is crucial in providing the air transport industry with competent and highly professional employees.

The classification and features of the educational services market are of interest because of the commercialization of education and the widespread increase in the level of requirements for staff qualifications. Professional education is a distinct sector within this market. There is a growing body of research that suggests that there is a need for a market structure for education and training services that is based on an integration of corporate training centers, industry bodies, and government.

Although training and retraining of specialists in civil aviation is an essential part of the production process, it can also be argued that aviation introduces innovations to the education sector through the use of new technical means, modern material and technical base, staffing, and the creation of

new forms and methods of training. The aviation specialist training industry is a component of the educational market. It provides training for aviation and encompasses a diverse range of characteristics that graduates acquire and industry specialists cultivate.

Markets are classified into different types based on the commodity and business peculiarities. However, they all share certain obligatory features below:

- Unregulated demand: Airlines and individuals determine the amount of training and retraining services they need to purchase.
- Unregulated supply: Flight schools, training centers, and aviation universities make independent decisions on how to offer their products to the market;
- Commodity prices are determined by supply and demand rather than by directive methods.

Therefore, it could be contended that the market for ATC services possesses all of these characteristics and is a distinct market. At the same time, it is a cluster market of aviation training professional training market.

Cluster market of civil aviation training complexes services. The term 'cluster' is borrowed from economic science, specifically from the competition theory. The term 'cluster' is often used interchangeably with 'destination' or 'complex'. The term 'cluster' is derived from the Old English word 'clustre' or 'clyster'. (Webster, 1994) This term was first coined by Michael Eugene Porter in his book named Competitive Advantage of Nations, published in 1990 by Free Press. According to M. Porter, a cluster is defined as 'geographical concentrations of interrelated companies, specialized suppliers, service producers, firms in closely related industries, and associated institutions (such as universities, standards agencies, and trade associations) in separate areas that compete but also cooperate.' (Porter, 1998)

It is important to note that M. Porter introduced this concept for firms and companies located in the same geographical area and united by common goals when entering the market. It was demonstrated that a company's competitiveness is primarily influenced by the competitiveness of its economic environment. This, in turn, is dependent on the underlying conditions (common resources) and competition within the cluster.

From a systems approach perspective, a cluster is a group of economic entities from different industries that are interrelated and united under a single organizational structure. The elements within the structure are interdependent and function together for a specific purpose. (Peter Maskell and Mark Lorenzen , 2004)

Since the start of the 21st century, the term has been commonly used in foreign theory and practice in relation to the conceptual field of education.

In our case, a cluster is defined as an economic complex of enterprises concentrated in the regional air transport market. The participants are connected in a single chain of value creation for a complex educational product. They have a management structure, a mechanism for coordinating and regulating economic activity, and cooperate in the common interests of attracting customers and increasing the international competitiveness of the destination.

The aviation training complex cluster comprises the relationships between civil aviation entities to provide training center services and ATCs (see Fig. 1).

The market for civil aviation training complexes is a set of economic relations between producers, represented by ATC, and consumers, represented by airlines, state civil aviation authorities, and private individuals. It operates based on the laws of the market economy model, including the laws of supply and demand, value, accumulation, and growth of labor productivity.

The ATC services cluster has its own unique development trends and characteristics. Considering the expansion of international relations in air transport, the

growing proportion of international air traffic, the use of increasingly complex equipment, and the rising demands for safety and quality of flight personnel, there is a need to establish aviation training centers that provide in-depth study of the English language and various types of aircraft. In summary, the market is expected to continue its upward trend in the near future.

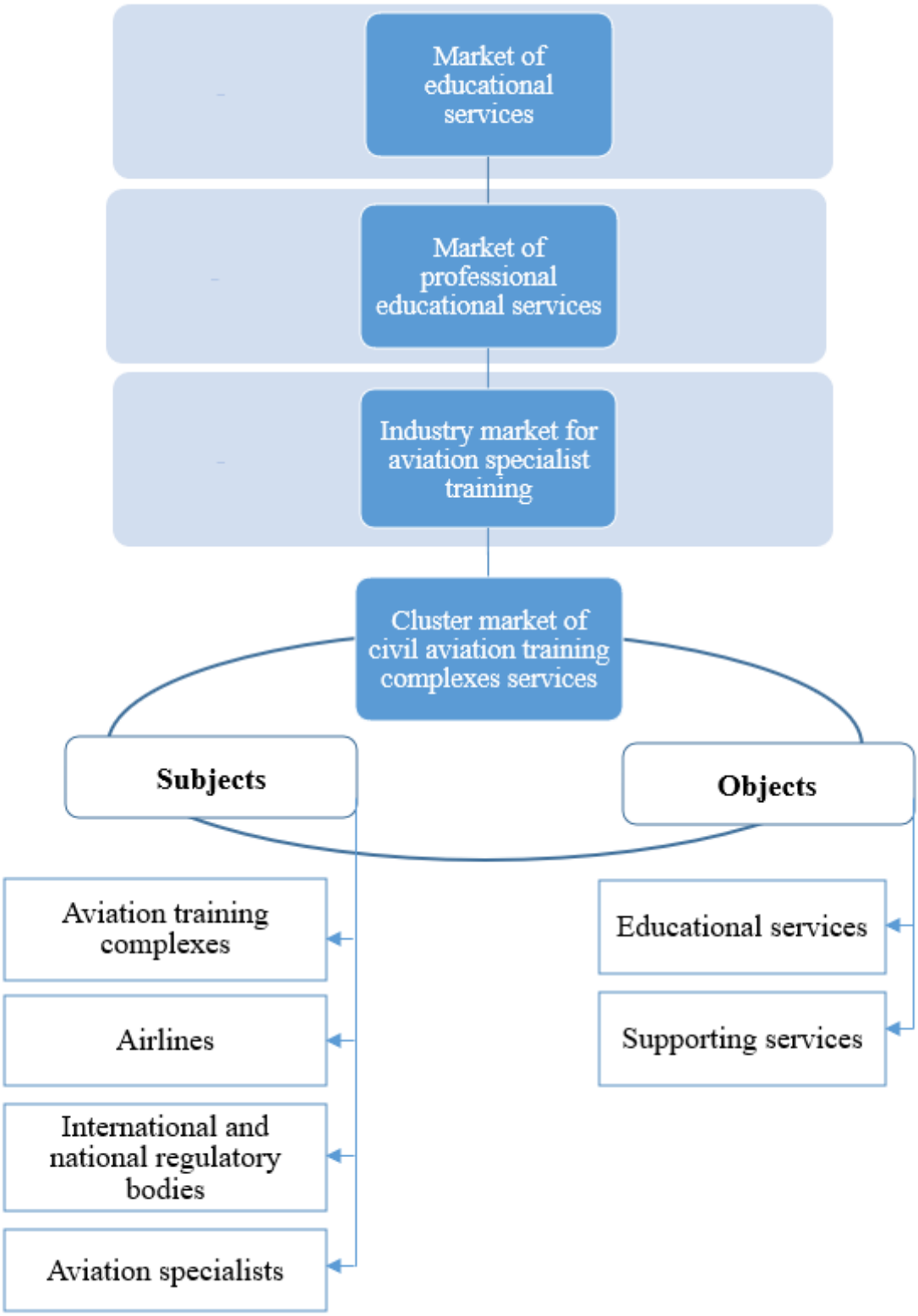

Figure 1 – The cluster market of civil aviation training complexes' services.

The ATC services cluster market has a specific feature below:

- as a system it is connected to multiple components that are interdependent;
- market conditions undergo frequent fluctuations and require constant monitoring for flexible response;
- the product must be differentiated based on the consumer's needs;
- presence of market entry barriers (certification, ICAO requirements);
- there may be a potential mismatch between the consumer and the payer being the same person.

Producers in the cluster market of civil aviation training complexes' services are legal state and commercial training centers that have undergone appropriate accreditation and obtained a license to conduct educational activities. They offer educational programs for initial training, retraining, and advanced training of aviation specialists in accordance with the requirements of ICAO and EASA standards, as well as the state educational standard. These entities interact with flight schools and higher education institutions in the aviation field to form a comprehensive and coherent system of aviation education and providing high-quality training for professionals.

The ATC services market is developing under the guidance of ICAO, which aims to provide civil aviation enterprises and States with access to skilled professionals to support the sustainable development of air transport.

To enhance air transport safety and efficiency worldwide in a cost-effective manner, ICAO implements the TRAINAIR PLUS programme (ICAO, 2024). This cooperative network of civil aviation training centers works together to develop and deliver courses based on ICAO-agreed standardized training package methodology. The programme provides technical expertise, resources, and quality assurance to support both new and existing aviation training centers. Public and private civil aviation training centers share an international pool of training courses and have access to an international system for the exchange of model training materials.

Aviation Voice provides an annual ranking of the world's aviation training centers. Aviation training centers are evaluated using a comprehensive methodology. A panel of data experts assesses the centers against 18 carefully selected performance indicators to provide a comprehensive and balanced rating that covers all areas of training. This includes the number and types of programmers, availability of cadet courses, aviation research, student and instructor enrolment data, and information on the size of the fleet and the network of flight training facilities. As of 2023, there are 186 aviation training facilities worldwide, with 60 in European countries, 25 in North America, 38 in Asia-Pacific, nine in CIS countries, 23 in Africa, 15 in the Middle East region, and 26 in Latin America (Aviation Voice, 2023).

The primary means of production for the cluster market of civil aviation training complexes services are aircraft simulators of various types and their spare parts.

One of the primary semantic units in defining a market is its product. The market deals with the products of training centers and ATK resulting from labor activities that directly impact a person during the learning process. The aviation training market produces the following products:

- Training aviation specialists involve providing instruction to flight crew members, cabin crews, aviation technical support staff, aviation safety and regime management staff, operations management staff, ground support staff, and air traffic controllers. Special training is also provided to employees as needed;
- Advanced retraining of aviation specialists;
- Retraining of aviation specialists;
- Organize and conduct training for flight, dispatch, and engineering personnel on flight simulators and aircraft.

The competitiveness of an aviation training center's product is determined by a

complex of various factors that affect its ability to attract and retain consumers, such as airlines (customers) and aviation specialists (trainees), in a competitive environment. (Faster Capital, 2024) The competitiveness of the ATC services is determined by several factors:

- Licenses and accreditation (availability of all necessary licenses for simulators and educational programmes, ATC accreditation);
- Quality of education (effectiveness of educational programmes, experience and qualification of teaching staff, as well as learning outcomes in the form of successful graduates of the educational process);
- Infrastructure and technical equipment (availability of modern training facilities, laboratory and various types of flight simulators);
- Innovation in learning (use of latest learning methodologies (e.g. competence-based learning), technologies (e.g. microlearning) and modern educational platforms (e.g. e-learning));
- Trainees support system (tutoring, career counselling, etc.);
- ATC's image;
- Pricing strategy (tuition fees, discounts or flexible payment terms);
- Partnership (possibility of providing additional services (hotel, tourist trips, etc.));

Aviation personnel training and retraining centers aim to provide employees with theoretical knowledge, practical skills, high efficiency, stress resistance, creativity, teamwork abilities, and a sense of responsibility for their actions. ATCs currently offers the following types of aviation training services in the specified areas: Ab-initio pilot training; preparation for authorization to operate a certain type of aircraft (Type-rating); students training; training and retraining of flight attendants; training and retraining of ground handling specialists; training and retraining of helicopter pilots; training of unmanned aerial vehicle operators.

Conclusions. The demand for aviation training and related services is displaying indications of a quicker recovery. However, the training industry is still encountering challenges in fulfilling this demand. Insufficient training capacity and staff shortages are limiting factors in the aviation industry. Additionally, training of the aviation specialists is a time-consuming process. ATCs should modernize and expand their training capabilities by procuring new simulator equipment to train more aviation specialists, while complying with regulatory certification criteria.

A study of the aviation training complex market reveals that in addition to aviation training centers operated by airlines (joint activity - joint venture training centers), there are also those operated by the government (government-owned, contractor-operated), state-owned (government-owned, government-operated), or an independent legal entity (company-owned, company-operated). An example of aviation trainer complexes can be seen in the market leader who established the network of civil aviation training centers, such as CAE Training Centers and BAA Training Centers.

It is financially impossible for even large, successful airlines to create training centers equipped with a full range of technical means for training aviation personnel with simulators of the highest standards, due to the high market value of these enterprises. Experience has shown that when purchasing and implementing new aircraft simulators, investors, including the state and air carriers, face high operating and maintenance costs in addition to the initial purchase price of the equipment.

ATC, along with other educational institutions, is not considered a commercial organization. Therefore, the management of ATC's commercial activities and profitability is not well studied. It should be noted that while there are numerous studies on civil aviation training and technical aspects of aviation simulators, there is a lack of comprehensive research on management processes and marketing in ATC. The commercial aspects of ATC activities require a comprehensive study to improve efficiency and increase its profits

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The electronic scientifically and practical journal
"INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT",
ISSN 2708-3195

61-69
v.24 (2024)
https://smart-scm.org

UDC 656.7.072 (045)
DOI: https://doi.org/10.46783/smart-scm/2024-24-6
JEL Classification: M12, M21, Q20.
Received: 9 March 2024

Bugayko D.O. Doctor of Science (Economics), Professor (Full), Corresponding Member of the Academy of Economic Sciences of Ukraine, Vice - Director of ES International Cooperation and Education Institute, Instructor of ICAO Institute, Professor of the Logistics Department National Aviation University (Ukraine)

ORCID – 0000-0002-3240-2501
Researcher ID – ABF-5564-2021
Scopus author id: – 57216582348

Mammadov Ramil Chairman of the Board State Inspection on Civil Aviation Flight Safety of State Civil Aviation Agency, Ministry of Digital Development and Transport (Azerbaijan)

ORCID –
Researcher ID –
Scopus author id: –

Akhmadov Huseyn Senior Lecturer National Aviation Academy (Azerbaijan)

ORCID –
Researcher ID –
Scopus author id: –

METHODS FOR RISK ASSESSMENT IN THE AVIATION SAFETY MANAGEMENT SYSTEM

Dmytro Bugaiko, Ramil Mammadov, Khusein Akhmadov. "Methods for assessing risks in the aviation safety management system". *The relevance of the topic is due to the fact that the civil aviation of the Republic of Azerbaijan is intensively implementing the recommendations of the international organization ICAO on the "Theory and Practice of Risk Management" in order to reduce the accident rate in air transport. It is proposed to determine the safety indicators of aviation systems through risk in order to carry out an objective measurement of the level of safety, taking into account many possible risk factors. The problem of risk management currently cannot be solved in an integrated form, since the necessary tools are missing. Therefore, a particular problem is proposed for solution, which consists in risk management exclusively in the field of flight safety. Investigated based on the results of a synthesis of materials from scientific foreign publications on the problems of creating promising flight safety management systems in civil aviation using risk management methods in the sense of ICAO definitions.*

This article also discusses the problem of risk identification, risk definition, many different risk management methods and different principles for their classification. A generalization is made on risk management within the framework of new directions for assessing flight safety, taking into account statistical data and monitoring results in civil aviation (CA).

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https://smart-scm.org

***Keywords**:* ICAO, flight safety management system, flight safety, hazard factors, probability, threat, risk, risk management, risk management methodologies, risk magnitude, acceptable risk

Дмитро Бугайко, Раміль Мамедов, Хусейн Ахмадов. "Методи оцінки ризиків у системі управління безпекою польотів". *Актуальність теми обумовлена тим, що цивільна авіація Азербайджанської Республіки інтенсивно впроваджує рекомендації міжнародної організації ІСАО з «Теорії та практики управління ризиками» з метою зниження аварійності на повітряному транспорті. Пропонується визначати показники безпеки авіаційних систем через ризик з метою проведення об'єктивного вимірювання рівня безпеки з урахуванням багатьох можливих факторів ризику. Проблема управління ризиками наразі не може бути вирішена комплексно, оскільки відсутні необхідні інструменти. Тому для вирішення пропонується окрема проблема, яка полягає в управлінні ризиками виключно у сфері безпеки польотів. Досліджено за результатами узагальнення матеріалів наукових закордонних видань з проблем створення перспективних систем управління безпекою польотів у цивільній авіації з використанням методів управління ризиками в розумінні визначень ICAO.*

У цій статті також обговорюється проблема ідентифікації ризику, визначення ризику, багато різних методів управління ризиками та різні принципи їх класифікації. Зроблено узагальнення щодо управління ризиками в рамках нових напрямків оцінки безпеки польотів з урахуванням статистичних даних та результатів моніторингу в цивільній авіації (ЦА).

Ключові слова: ICAO, система управління безпекою польотів, безпека польотів, фактори небезпеки, ймовірність, загроза, ризик, управління ризиками, методології управління ризиками, величина ризику, прийнятний ризик

Introduction. One of the most troubling and paradoxical consequences of globalization has been its impact on risks: while globalization has significant potential to mitigate the impact and reduce the likelihood of some risks - local and global, natural and man-made - it has contributed to the spread and amplification of the impact of other risks . The increasing complexity and interconnection of global supply chains spanning continents and oceans has had many positive consequences, but has also, directly and indirectly, led to a series of events that have resulted in loss of life, environmental degradation and economic hardship.

To everyone's benefit, globalization has also stimulated significant scientific and technological progress, resulting in increased prosperity for society. Such developments, of course, carry their own risks, but they have also provided humanity with the opportunity to better defend against their threats. Risk management tools are widely used in civil aviation and in regulatory development. However, in many cases, regulators, regulated companies and other regulatory stakeholders use different terms and refer to different models when talking about risk and risk management.

Risk is a human instinct for the most intense, varied life, for expanding its limits beyond the existing field of activity and self-preservation. Risk does not exist outside of consciousness and culture. Man created it to adapt to dangers. Risk is considered as a fuzzy measure of acceptable business outcomes. Acceptable can be something that society agrees to or rejects. If a way of life improves the quality of life and the value outweighs the risk, then this way of activity is considered acceptable. "Risk is the possibility that human actions or the results of his activities will lead to consequences that affect human values". Risk is associated with the uncertainty of the outcome of an activity. The manifestation of risk can be deterministic systematic or random stochastic.

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The history of the emergence of the concept of "risk" has been examined in some detail by various authors and their conclusions, as a rule, do not always coincide with each other. The word "risk" has ancient roots - translated from the Old Italian "risicare" means "to dare." The history of the formation of the concept of "risk" is largely connected with a person's attitude towards the future. There are numerous concepts and names of risk: one-dimensional, multidimensional, dependent and independent of humans (natural disaster); individual: motivational, active, passive, voluntary, forced; social: personal, group, business, organizational, deterministic systematic, random stochastic, accepted, acceptable, voluntary, conscious, conscious, controlled, assessed, regulated, controlled, neglected, acceptable, unacceptable, tolerable, residual, processed. The subject of risk is studied in the human sciences, in philosophy, psychology, in technosphere activities, in economics and finance - as an expectation of negative outcomes of activity.

Risk is a multidimensional concept. The same risk may include money, the environment, the lives of people with unclear frequencies of the magnitudes of their manifestation. In simple form, the amount of risk is the total value of the expected outcomes or the expected value of an event or action. The concept of risk is associated with the expectation of negative results from activities: danger, loss, damage, harm, illness, injury, death, accident, catastrophe. The etiology of the term "risk" in the concept space is of unclear origin and makes it difficult to identify the actual subject of risk. Vocabulary and grammatical descriptions provide the following information for understanding risk. Risk, Greek ριζα, riza root, base, foot of the mountain; Spanish risco rock, underwater rock, reef; fr. Ch. risquer to maneuver between rocks, to take risks. In European languages from the 15th century, risicum takes on the legal meaning of "loss", "damage" in maritime trade; Arab. rischio and riezgo "in search of prosperity." According to S.I. Ozhegov, risk is the possibility of danger, failure; act at random, in the hope of a happy outcome; at your own responsibility. Much earlier, the concept of risk was outlined in Arnaud-Nicole's work "Logic or the Art of Thinking," 1662: "The fear of harm must be proportional not only to the severity of the harm, but also to the probability of the event". Let us pay attention to the key words of this description: "event", "harm", "proportionality", "probability". Note that the term "risk" is missing. In general, the origin of the term "risk" according to dictionary descriptions remains unclear. The connection between the concept of risk and damage expectations is also unclear.

The challenge of risk identification is the following: a) unclear definition of the term "risk", b) incoherence of alternative risk classification in various subject areas, c) the need to substantiate the risk paradigm, d) the need to substantiate the definition of risk through uncertainty, d) the need to substantiate the definition of risk as negative consequences through a combination of chances and consequences, f) the need to substantiate the paradigm of risk management and/or regulation.

Definition of risk: Risk (R) in this work defines a set of measures for monitoring randomness and a measure of measuring the outcome of events that ensures activity in a given environment and environment.

$$R = H \cdot Ex \qquad (1)$$

H - randomness hazard,
Ex – consequences (exodus).

The fundamental differences between this definition and existing normative descriptions of risk are the following replacements of concepts: a) measures of

randomness of an event (instead of probability), revealed in the choice of fuzzy measures: likelihood, possibility, likelihood, trust (belief), necessity (confidence); b)measures of outcome instead of the amount of damage, revealed in the nature of the event "where the scales tip" for a positive or negative outcome and in calculating the magnitude of the outcome of the event; introducing the following concepts: c) purposeful activity; d) habitat, given or artificially created; e) the environment for the destination of the activity, chosen or assigned. The meaning of the content of points (c-e) is that without the existence of expediency and the living environment, the subject of risk does not exist. In the proposed definition of risk, replacing the concept of probability with the broader concept of randomness is based on the following. The classical definition of probability considers random events with a stable frequency that decay into a finite number of equally probable cases. Of these, one event is determined as real, probable (by faith, clear, obvious) from many possible ones. The classical definition is often inapplicable when solving natural science and economic problems, since events fall into an infinite number of possible incompatible cases. Then the probability is not determined, but its existence is only postulated and a method is indicated for an approximate determination, which is called statistical [9]. The solution to this problem is considered in limit theorems, testing hypotheses about distribution parameters, and in the theory of estimation using the maximum likelihood method [10]. Replacing the concept of damage with a measure of the magnitude of the outcome is based on the practical use of various tools for assessing events - "heat maps" and risk matrices. They present positive (green), transitional (yellow), and red (negative) assessments of object states.

The understanding of risk with the semantics of "negative and undesirable" is explained by the historical concept and emphasis of the danger of the term risk. Since any life activity is associated with risk, this semantics should be considered incomplete and risk should also be understood in a positive sense. The structure and content of the elements of the subject of risk are incomparably more complex. A special case of the measure of randomness of an outcome is the calculable probability of an event. A special case of a measure of the magnitude of an outcome is the calculable damage of an event.

The risk management system offers tools for building a structured vision of the future and solving the problem of associated uncertainty. In civil aviation (CA), all aspects of its life are, to one degree or another, related to flight safety. In this sense, the flight safety system is presented as a means of eliminating all types of danger in civil aviation. In order to meet this requirement, it is proposed that the flight safety system be considered as a quality system, the main task of which is to regulate the relationship between the three basic characteristics that regulate the functioning of civil aviation: reliability, economics and law. In the process of regulation, such a system exhibits three interrelated functions or three directions in which the task of ensuring safety is solved. Problems of safety management system (SMS) should be considered in the context of the general state policy in the field of safety, the formation of which is carried out on the basis of the concepts of sustainable development and acceptable risk.

The safety of aviation activities is considered as the overall safety of the industry, including the following aspects: safety of aviation; aviation security; industrial safety; environmental safety; information security. Risk management is a key element of any safety management system, including the Safety Management System (SMS). In practice, several basic risk concepts are used:

- risk as a characteristic of potential danger, as the possibility of negative events that cause harm;

- risk as a measure of discrepancy between the results of decisions in terms of

their usefulness, and as the possibility of implementing worse alternatives;

- risk as the relationship between losses and profitability, including the concept of "chance" - receiving an unplanned benefit.

When managing safety risk, the main one is usually the first of the listed concepts, which corresponds to the ICAO approach, but in the actual production activities of civil aviation, the other two are also used.

The greatest methodological problems are associated with the identification of hazard factors and risk assessment. Since PD is defined by a state in which the risk of PD is maintained at an acceptable level, it is necessary to be able to estimate the value of the risk and compare it with a given acceptable level.

An analysis of various definitions of safety risk shows that the use of two groups of key terms is common:

- "probability", "opportunity", "possible danger", "threat", "risk factor", "hazard factor", characterizing the randomness of the impact of a negative factor, the probability, degree of possibility or frequency of the occurrence of a negative event;

- "loss", "losses", "damage", "deviation of the result from the planned", related to the consequences of this event.

There are many different risk management methods and different principles for their classification. It is proposed to divide all methods into phenomenological, deterministic and probabilistic.

The phenomenological method is based on determining the possibility or impossibility of an emergency process and gives a result if the current state of the components of the system under consideration can be confidently determined. It can be used to determine the comparative level of safety of various types of industrial installations, but is of little use for analyzing processes, so it is rarely used in civil aviation practice.

The deterministic method involves analyzing the sequence of accidents starting from the initial event. The progress of the process is studied and predicted using calculations and mathematical modelling. Disadvantages include the potential to miss important chains of events and the difficulty of building adequate models. Can be used in risk analysis for power supply, taking into account the ever-increasing capabilities of computer technology.

The probabilistic method involves both assessing the probability of an accident occurring and calculating the relative probabilities of one or another path of process development.

In the civil aviation practice, a combination of all three methods is actually used. Methods are also conventionally divided into qualitative, semi-qualitative (mixed) and quantitative. They can be deductive or inductive.

Methods of expert assessments. (Brainstorming, Delphi Method). At this stage of development of risk management, including aviation safety risks, the role of expert assessments is extremely important. Only an expert is able to process heterogeneous information based on his experience and intuitive ideas and synthesize an appropriate conclusion.

Expert assessments are used in cases where formal methods are too complex and the initial basis is insufficient to obtain an analytical solution. Both group and individual assessments are used. Application areas can be:

- assessments and likelihood of events and the severity of their consequences;

- forecasting the development of events;

- opinions on the work of other specialists or organizations.

Several types of expert assessments are used, which are essentially determined by the type of expert survey. The main types are: brainstorming, structured or semi-structured interviews, Delphi method.

It should be noted that expert activities in each area must be regulated by relevant regulations and carried out in accordance with certain methodological materials. Since there are no regulatory documents or expert

forecasting guidelines in the field of power supply management, airlines are developing their own methods.

The control chart method and the "what if?" method (Checklists, Structured What-If Scenario Analysis) are qualitative methods based primarily on examining the compliance of operating conditions with safety requirements. These methods are widely used in safety management systems. For example, the Canadian guide contains a special program called Q-850, in which checklists are tools for assessing hazards and risk reduction options. Next, a step-by-step scenario of the event and corrective action is drawn up. The "what if?" method declared as one of the main ones in the US FAA program.

The method of studying operational hazards (Hazard and Performance Study) is based on the fact that deviations from the usually observed level of various process parameters indicate the presence of existing or developing problems. The basic hazard and performance study procedures are similar to control chart procedures. In relation to technical systems [16], this is the deviation of specific variables from the nominal value. For a complex human-machine system, such as an a/c, these are deviations, inconsistencies and events identified during the assessment of operational activities.

This method includes: ***analysis of the types and consequences of failures, analysis of the types, consequences and criticality of failures, analysis of causes and consequences, analysis of hazards and operability.*** All of these methods involve examining each component part of the system for what brought it out of normal functioning and how the "abnormality" in the operation of this part affects the system as a whole. The combination of these methods is called Operations Analysis. A classification of failures according to the criteria "probability - severity" is provided. This classification can be specified for each object, technical device, part of the system (in our case, for each area of the airline's activity) taking into account its specifics. Thus, we arrive at the "risk matrix" (Matrix of consequences and probability), which in a number of manuals also provides for quantitative assessment. That is why these methods can be called "mixed" or "semi-quantitative". The main drawback of these methods is rightly noted - the difficulty or impossibility of using them to analyze combinations of events leading to an accident.

Preliminary hazard analysis (Preliminary Hazard Analysis) is an inductive method designed to identify hazards at all stages of system operation. The results obtained can be presented in various ways, for example, in the form of tables or a tree system. The method is recommended in a number of manuals. The Pilots Association IFALPA manual provides a technique for compiling a typical Preliminary Hazard List, using some of the methods we mentioned. The initial data (input) is all available information on the aviation safety: aviation events, hazardous external influences characteristic of the airline, recorded personnel errors, etc. Next, a list of the main hazards in the airline's activities (output) is compiled using the brainstorming method. An example of such a list is given, which contains more than 50 main hazards, for example, an aircraft collision in the air, dangerous weather phenomena, etc. Next, the development of a scenario using the "what if?" method is prescribed. An example of a hazard identification system is the Australian Transport Safety Bureau's INDICATE program. To a certain extent, preliminary analysis of factors is carried out constantly in the civil aviation activities. The effectiveness of this method will be determined, first of all, by the completeness of the accounting of dangerous situations. The method involves carrying out a large amount of work and constantly updating the list. The method is most useful for a small vehicle. For an airline with a large fleet of different aircraft, a wide flight geography, and a large charter program, compiling a list of dangerous situations will be a much more voluminous

and time-consuming task. The method of analysis of personnel errors (Analysis of the influence of human factors) is used for the qualitative assessment of events associated with personnel errors ("Method of analysis of personnel reliability"). The method is important for a human-machine system such as an airline.

A human error is an action that is performed or not performed under certain conditions. In probabilistic safety analysis, this issue is considered from the standpoint of personnel reliability analysis. Qualitative reliability analysis is carried out in order to determine the logical-time structure of the algorithm (instructions) for performing each personnel function in the specific conditions of their work in managing the system and the consequences of possible erroneous actions of personnel. An example of a method for qualitative assessment of personnel errors is the "Guide to Avoiding Errors in Maintenance," developed by Boeing. Quantitative characteristics of human errors are obtained using the Technique for Human Error Rate Prediction, the Accident Sequence Evaluation Program, or the Human Factors Analysis and Classification System. System), a description is given in the work of the Dutch Institute for Transport Safety (NLR)].

Fault tree and event tree analysis methods are effective methods for analyzing the conditions for the occurrence of undesirable events. Fault tree analysis is a method for identifying and analyzing factors that may contribute to the occurrence of the undesirable event under investigation (called the final event). Using deduction, the factors under study are identified, arranged in a logical manner, and presented in a diagram in the form of a tree that displays these factors and their logical relationship with the final event. The tree is built from top to bottom - from the final event to the initiating events, and then to the factors that cause them.

The event tree is built in the opposite direction - from the initiating event through intermediate ones and allows you to calculate the risk in terms of the probability of the main event. The event tree method is the main tool for probabilistic safety analysis.

In aviation practice, these methods are usually used individually to a limited extent, only for assessing private events. It is more effective to use a combination of both methods, called cause and effect analysis. The work begins with consideration of the final event and analysis of its consequences using YES/NO logical elements (fault tree method). The causes of the conditions or failures are then analyzed using the fault tree method. Foreign experience in developing similar systems (I-Risk, ARAMIS, WORM). The closest in scope is the Cause-and-Effect model for aviation security, which we will dwell on in more detail. The program was developed by a group of scientists from the Netherlands Institute for Transport Safety on behalf of the Dutch Ministry of Transport in the period from 2003 to 2009. using developments and software products from universities and research centers in many countries. The goal is to identify the sequence of events leading to an accident, assess the existing "safety barriers", assess the risk (as the likelihood of an accident and the severity of the consequences), and develop preventive measures. A list of types of events (33 types) that can occur at various stages of the flight has been developed. Causal models have been developed for each type of event at each stage of flight. This model is a sequence diagram of events and fault trees connected by a single Bayesian belief network. Failure trees were built based on descriptions of aviation accidents and incidents related to the accident category under consideration.

To estimate the probability of an accident, this model uses probability density distributions of hazards rather than point estimates. To obtain distributions, various databases were used, the main ones being:

- ICAO aviation events database;
- Database of airlines and airports.

Thus, the model uses the method of Bayesian analysis and Bayesian networks. Disadvantages of the model:

- the reliability of the calculations has not been checked; a simple comparison with similar assessment models is assumed;

- the model is developed for the safety of air transport as a whole, the features of individual aircraft are not considered, and accordingly, real airline operating data (failure data) is not used;

- the risk in this model does not include the amount of damage in monetary terms; only the loss of life and loss of aircraft are considered.

Tree methods are related to cause-and-effect analysis. For more complex events, the cause-and-effect diagram of the Japanese management theorist Kaora Ishikawa "fish skeleton" can be used.

Analyzing protection levels is important for an airline. It is a mixed method for assessing the risk associated with an adverse event or scenario. It aims to analyze the adequacy of measures to control or reduce risk and is based on the selection of cause-effect pairs and the identification of levels of protection that can prevent the cause leading to the undesirable effect. To determine the adequacy of risk reduction measures to an acceptable level, it is necessary to calculate the consequences.

Risk analysis using graph diagrams is the second (after the event tree) type of cause-and-effect diagrams. There are two types of graphs:

- transition and state graphs;

- flow graphs.

It is noted that graph-type models in the form of influence diagrams have long been used in security research models. Their advantage is the convenience of transition to iconic models and the derivation on their basis of mathematical formulas of the relationship between previously selected quantitative safety indicators and the main parameters of human-machine systems. The resulting analytical expressions can be used for a priori (preliminary) and a posteriori (actual) assessment of the level of risks. Process models using graphs are found quite often in research works on business safety, but in practical methods for managing security risks this method is not yet in sufficient demand.

Conclusions. In article conducted conceptual and terminological research in the sphere of aviation safety&security risk management. The existing normative description [risk = probability x consequences] for risk calculus is based on probability theory as a relatively developed branch of mathematics. This description is a single expression of the risk assessment. An analysis of known risk assessment methods has shown that many of them can be used to assess the risk for aviation safety security, however, at present, only qualitative risk assessment technologies are effectively used in individual aviation organizations, mainly the "consequences and probabilities matrix" method. The insufficient implementation of quantitative methods in civil aviation is associated, firstly, with an overestimation of the capabilities of the "risk matrices" recommended in the documents, and secondly, with the lack of specialized databases and computer programs on the market for processing the results of the analysis of deviations in the operational activities of the civil aviation.

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The electronic scientifically and practical journal
"INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT",
ISSN 2708-3195

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v.24 (2024)
https://smart-scm.org

UDC 334.4:656.7
DOI: https://doi.org/10.46783/smart-scm/2024-24-7
JEL Classification: C80, M41, O30.
Received: 12 March 2024

Molchanova K.M. PhD (Economics), Associate Professor at the Logistics Department, National Aviation University (Ukraine)

ORCID – 0000-0003-1846-2492
Researcher ID – S-7289-2018
Scopus author id: – 58149305600

MODERN APPROACHES TO THE FORMATION OF SYSTEMS FOR EVALUATING THE LEVEL OF ENTERPRISES DIGITIZATION

Kateryna Molchanova. "Modern approaches to the formation of systems for evaluating the level of enterprises digitization". *The article examines the essence of the concept of digital transformation of enterprises, which includes the introduction of digital technologies into the enterprise's business processes, management processes, and communication processes. The available approaches to assessing the level of digital transformation of enterprises, which is a necessary tool for further development strategy, were analyzed. It was determined that existing studies and scientific publications on the formation of systems for evaluating the level of digital development need some refinement, taking into account the specifics of the enterprises to which they are applied.*

A unique approach to forming an assessment of the level of digital transformation of aviation enterprises was proposed, according to which it is proposed to apply an integral assessment that takes into account indices of digital activity, maturity and interaction. The advantage of this approach is taking into account the specific processes inherent in aviation industry enterprises and forming a tool that allows you to assess the possibility of functioning of various aviation market subjects in a single information field.

Special attention was paid to the method of calculating indicators that are part of the indices of digital activity, maturity and interaction.

Thus, the assessment of the level of digital transformation of aviation enterprises will allow in the future to develop a joint strategy for the formation of a digital space in which the subjects of the aviation market will function.

Keywords*:* digital transformation, methods of digital transformation evaluation, digitalization, platformization, digital economy, digital readiness

Катерина Молчанова. «Сучасні підходи до формування систем оцінювання рівня цифровізації підприємств». *У статті розглянуто сутність поняття цифрової трансформації підприємств, що включає впровадження цифрових технологій в бізнес-процеси підприємства, в управлінські процеси, в процеси комунікації. Було проаналізовано наявні підходи до оцінки рівня цифрової трансформації підприємств, яка є необхідним інструментом для подальшої стратегії розвитку. Було визначено, що наявні дослідження та наукові публікації щодо формування систем оцінювання рівня цифрового розвитку потребують певного доопрацювання з урахуванням специфіки підприємств, до яких вони застосовуються.*

Був запропонований власний підхід до формування оцінки рівня цифрової трансформації авіаційних підприємств, згідно з яким пропонується застосовувати інтегральну оцінку, яка враховує індекси цифрової активності, зрілості та взаємодії. Перевагою такого підходу є врахування специфічних процесів притаманних підприємствам авіаційної галузі та формування інструменту, який дозволяє оцінити можливість функціонування різних суб'єктів авіаційного ринку в єдиному інформаційному полі.

Особлива увага була приділена методиці розрахунку показників, що входять до складу індексів цифрової активності, зрілості та взаємодії.

Таким чином оцінка рівня цифрової трансформації авіаційних підприємств дозволить в майбутньому розробити спільну стратегію формування цифрового простору в якому будуть функціонувати суб'єкти авіаційного ринку.

Ключові слова: слова: цифрова трансформація, методи оцінки цифрової трансформації, цифровізація, платформізація, цифрова економіка, цифрова готовність

Introduction. Digital technologies play one of the most important roles in today's society. Various gadgets have become a person's constant companions, and access to the Internet is currently defined as one of the necessities of life. The rapidly growing role of digital technologies in our lives is evidenced by the growing number of Internet users. So, in 2005, their number was 1.023 million people, while in 2023, this value is already 5.400 million people, that is, it has increased more than 5 times. Today, almost two-thirds of the planet's population is connected to the global web [1].

Rapid digitization leads to changes in communication processes, document flow, business processes of the enterprise, and the use of digital technologies becomes one of the most important factors of the company's competitiveness. In tough market conditions, the management needs to understand the level of digital transformation of the enterprise at the moment, what latest technologies are appearing on the market and whether there is a need for their implementation, what are the potential advantages and risks.

Different approaches can be used to assess the level of digital transformation, taking into account the specifics of the activities of enterprises and what the management is focusing on in order to improve efficiency. There are already established methods, but the rapid development of the latest technologies leads to the need to constantly revise approaches to the formation of evaluation systems.

Problem statement (formulation of research purposes). In today's conditions, in order to maintain competitiveness, enterprises must seriously approach the issue of choosing a method for evaluating digital changes in the company. The development of the further strategy of the enterprise will depend on the quality and completeness of the assessment of the state of digital transformation [2].

The list of indicators by which the state of digitization is measured directly depends on the level at which the assessment is made. It can be at the state, regional, industry level and directly at the enterprise. The research aims to analyze approaches to the formation of methods and indicator systems for assessing the state of digital transformation and is a continuation of a number of works [3, 4].

Approaches to the formation of methods for evaluating the digital transformation of aviation enterprises must take into account various specific factors. The aviation industry has always been high-tech, and the formation of a system of indicators for evaluating digital changes must take this fact into account. In our opinion, the existing indicator systems do not meet the specifics of the aviation industry

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and require adaptation to the operating conditions of aviation enterprises.

The main material and results of the research. The development of digital technologies gives airlines and airports the opportunity to increase the efficiency of their activities, the quality of the services provided, as well as to improve information interaction. However, it should be understood that the digital level of enterprises can be different due to different management systems, strategies, capabilities, approaches to the introduction of new technologies, etc. The different level of digitization of enterprises also affects the information interaction between them, it can be long, inefficient and contain errors.

The system of indicators of the level of airlines digital development can become a necessary tool for identifying factors that affect the level of information interaction between them [5].

Many methods have been developed (Table 1) that allow assessing the level of digitization of enterprises. The difference in the methods lies in the set of groups of indicators, the formation of the assessment, the methods of conducting the assessment (self-assessment, expert assessment, comparative assessment, etc.).

The analysis of various approaches to assessing the digital economy [6] allowed us to conclude that one of the most common methods is the index method, which is actively used by international and national organizations at the macroeconomic and micro level [3].

Table 1. Comparative characteristics of methods for assessing the level of digitization of enterprises

The name of the method	Developer	Indicators by which the assessment is carried out
1	2	3
1. Assessment of Digital Transformation	MIT Center for Digital Business and Capgemini Consulting	Evaluation in three key areas of digital transformation: customer experience, operational processes and business models. The total number of indicators is 9.
2. Digital Maturity Model	Deloitte	Assessing digital capabilities along 5 key dimensions: customers, strategy, technology, production, organization structure and culture. The total number of indicators is 179.
3. Digital Transformation Index	Arthur D. Little analytical agency	Conducting assessments in 7 key areas: strategy and leadership, products and services, customer management, operations and supply chains, corporate services and controls, information technology, workplace and culture.
4. Digitization piano	Global Center for Digital Business Transformation (created on the initiative of IMD and CISCO)	The digitization piano defines 7 distinct categories, any of which could be transformed digitally: the business model, the structure, the people, the processes, the IT capability, the offerings and the engagement model
5. Digital Transformation Assessment	Ionology	5 blocks of digital transformation are distinguished: strategy and culture, personnel and customers, processes and innovations, technologies, data and analytics.
6. Industrie 4.0 Maturity Index	Acatech National Academy of Science and Engineering	Assessment in 4 key areas of digital transformation: resources, information systems, culture and organizational structure.
7. A model for assessing digital aptitudes	KPMG	Assessment on 5 key dimensions: Vision and Strategy, digital talent, key digital processes, agile sourcing and technology, leadership.

Source: compiled by the author based on [7-13]

The most famous macro-indices are the following: Networked Readiness Index – NRI [14], E-commerce Index B2C – UNCTAD B2C ECI [15], ICT Development Index – IDI [16], E-Government Development Index – EGDI [17], Digital Economy and Society Index – DESI [18] and Global Digital Readiness Index – GDRI [19]. According to approximately all of

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the mentioned indices, Ukraine occupies an average place among the countries of the world.

However, the vast majority of the listed macro-indices do not reflect the economic and social consequences of digital transformations and do not take into account the peculiarities of the countries' development, which ultimately leads to a kind of adjustment of their indicators to the calculation requirements of the relevant international indices.

Most of the named indices are used to compare national economies and for a kind of benchmarking. Currently, there are attempts to develop digital indices for certain sectors of the economy.

Since there are significant difficulties in obtaining reliable statistical information regarding the use of digital technologies in the activities of aviation companies, the author proposed to use an index approach, namely to evaluate the level of digitization of the industrial and commercial activities of enterprises according to 3 indices [20].

1. The Digital Activity Index. This is a dynamic indicator that allows tracking the company's evolution in the use of digital technologies to optimize internal business processes in order to ensure business flexibility and reflects the level of adoption of digital technologies by the aviation enreprise. The digital activity index of the aviation enreprise is calculated according to the formula:

$$I_{DA} = \sum_{k=1}^{n} x_{1k} \cdot a_{1k} \quad , \tag{2.1}$$

where $x_{1к}$ – an indicator characterizing the digital activity of the enterprise,
$a_{1к}$ – indicator weight,
n – the number of digital activity indicators.

2. The Index of Digital Maturity. This index reflects the processes of creating value for the personnel, customers and stakeholders of the aviation company, that is, it is determined by the set of digital tools used by stakeholders for communications within the company and with the external environment. The digital maturity index is calculated according to the formula:

$$I_{DM} = \sum_{z=1}^{m} x_{2z} \cdot a_{2z} \quad , \tag{2.2}$$

where x_{2z} – an indicator characterizing the digital maturity of the enterprise,
a_{2z} – indicator weight,
m – the number of digital maturity indicators.

3. The Index of Digital Interaction. This index reflects the degree of use of digital services (digital platforms) to ensure interaction and partnership in passenger and cargo customer service chains. The index of digital interaction is determined by the formula:

$$I_{DI} = \sum_{p=1}^{h} x_{3p} \cdot a_{3p} \quad , \tag{2.3}$$

where x_{3p} – an indicator characterizing the degree of digital interaction,
a_{3p} – indicator weight,
h – the number of digital interaction indicators.

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The next stage after the determination of the three indices is the calculation of the integral index of the digital transformation of aviation enterprise according to the formula:

$$I_{ig} = {I_{DA}}^{\alpha} \times {I_{DM}}^{\beta} \times {I_{DI}}^{\gamma}. \quad (2.4)$$

where α, β, γ – dynamic weighting coefficients.

Quantitative assessment of any indicator can be carried out directly based on the results of its measurement, or, if such assessment cannot be established, then through expert assessment. The general method of determining indicators of digital activity, maturity and interaction is presented in Table 2.

Table 2. Methodology for calculating indicators of digital activity, maturity and interaction

Indicator	Symbol	Calculation methodology
1	2	3
1. The Digital Activity Index		
The level of information systems integration of the enterprise	x_{11}	(Number of integrated information systems) / (the total number of information systems of the enterprise)
The level of business processes automation	x_{12}	(Number of automated business processes) / (the total number of business processes that can be automated)
Quality level of connection	x_{13}	(Number of workplaces with broadband Internet access) / (total number of computerized workplaces)
The level of the corporate strategy development of digital transformation of the enterprise	x_{14}	Assessment of the level of development and implementation of the digital development corporate strategy of the enterprise (from 0 to 1)
Employees' understanding of the goals, importance and ways of digital development of the enterprise	x_{15}	(The number of employees who understand the company's digital development strategy) / (total number of employees)
Improvement of employees' skills in working with modern digital technologies	x_{16}	(The number of employees who attended professional development courses, trainings and seminars on the use of modern digital technologies over the past year) / (the number of employees whose job duties are directly related to digital technologies)
2. The Index of Digital Maturity		
The level of compliance of the aviation company website with the requirements of consumers	x_{21}	Assessment of quality and availability of information on the website and user-friendliness of the interface (from 0 to 1)
The digitization level of services for passengers	x_{22}	(Number of digital services) / (total number of services)
The level of digital services for cargo customers	x_{23}	(Number of digital services) / (total number of services)
The digitization level of service sales channels	x_{24}	(Number of digital sales channels) / (total number of sales channels)
The level of digital activity of customers	x_{25}	(Number of customers using digital sales channels) / (total number of customers)
The digitization level of communication channels with clients	x_{26}	(Number of digital communication channels) / (total number of communication channels)

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End of table 2

1	2	3
3. The Index of Digital Interaction		
The level of use of digital financial flow	x_{31}	(The number of transactions made using digital services for the specified period) / (the total number of financial transactions for the specified period)
The automation level of information exchange (electronic document flow)	x_{32}	(Number of documents transferred/received in electronic format for the specified period) / (the total number of documents transferred/received from the external environment for the specified period)
The level of use of integrated information solutions for coordination with other subjects of the air transport market	x_{33}	Assessment of the degree of use of integrated information solutions for coordination with other subjects of the air transport market (from 0 to 1)

Source: developed by the author

To determine the weight of the indicators, it is proposed to apply the method of expert evaluation, i.e. evaluation of the problem based on the opinions of specialists (experts) for the purpose of further decision making (choice). Expert evaluation is carried out in three stages - selection of experts, conducting a survey and processing its results. Methods based on the use of expert assessments are divided into two groups: individual (personal) expert assessments and group (collective) expert assessments. Individual expert evaluations are provided by each expert separately, independently of each other, and expert interviews can be conducted according to different procedures. Group expert evaluations are formed by a group (collective) of experts who agree on their opinion in an open discussion.

Gradation of airlines according to the integral index of digital transformation is carried out according to the scale shown in the Table 3.

Table 3. The scale of the digital transformation level of aviation enterprise

Integral index interval	Characteristics of the level
More than 0,90	High level of digital technologies development: most processes are digitized, high level of digital maturity and digital partnership
0,71-0,90	Sufficient level. Most business processes are digitized, the level of digital maturity is high
0,41-0,70	Middle level. The company works with digital technologies, but it needs to be expanded, it is necessary to acquire new digital competences or attract relevant specialists
Less than 0,40	Low level. Unstable development, changes in business processes and implementation of digital technologies are required

Source: developed by the author

Basically, the low level of digitalization of aviation enterprises is caused by the lack of a clear digital development strategy, insufficient involvement of company personnel in the processes of digital changes, and the low level of competence of employees in the processes of implementing digital technologies. The level of digital transformation and the insufficient integration of digital technologies into business processes also have a significant impact.

Conclusions. Today, aviation enterprises represent complex organizational structures in which each business process is characterized by the use of a certain

information system. In addition, the interaction of aviation enterprises with the external environment is characterized by a tendency to automate information exchanges. This, in turn, leads to the need for coordinated information interaction between the information systems of all participants in the transportation process. Considering how diverse the information systems used by airlines and airports are, as well as the fact that even within enterprises, information exchange between systems is not always established, the formation of a unified information environment is seen as a necessary means to improve the quality standards of consumer service.

An important step in the development of a unified information environment is the identification of factors that affect the level of information interaction between them. A necessary tool for this is a system of indicators of the level of digital development of aviation enterprises.

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https://smart-scm.org

UDC 351.86
DOI: https://doi.org/10.46783/smart-scm/2024-24-8
JEL Classification: H56, P44, H73.
Received: 15 March 2024

Andriienko M.V. Doctor of science (Public administration), professor, colonel of the civil defense service, head of the civil defense research center, Institute of Public Administration and Research in Civil Protection (Ukraine)

ORCID – 0000-0002-9222-4831
Researcher ID –
Scopus author id: –

Haman P.I. Doctor of science (Public administration), professor, head of the protection measures department, Institute of Public Administration and Research in Civil Protection (Ukraine)

ORCID – 0000-0003-1881-0397
Researcher ID –
Scopus author id: –

Ovcharenko B.O. Researcher of the Department of Protection Measures of the Research Center of Civil Protection, Institute of Public Administration and Scientific Research on Civil Protection (Ukraine)

ORCID – 0000-0002-8713-4700
Researcher ID –
Scopus author id: –

Gordeieiv P.M. Researcher of the man-made security sector of the scientific research center of civil protection, Institute of Public Administration and Research in Civil Protection (Ukraine)

ORCID – 0000-0002-0240-6683
Researcher ID –
Scopus author id: –

MAIN DIRECTIONS OF ENSURING NATIONAL SECURITY AND MECHANISMS OF PUBLIC ADMINISTRATION UNDER MARTIAL LAW

Mykola Andriienko, Petro Haman, Bohdan Ovcharenko, Pavlo Gordeieiv "Main directions of ensuring national security and mechanisms of public administration under martial law". *The task of ensuring national security is currently a key one for Ukraine, as a condition and goal of reforms in all spheres of state and social activity. The content of transformations in this area should be linked to ensuring and comprehensively strengthening Ukraine's sovereignty and preserving its territorial integrity. The current situation in the world is characterized by the presence of "points of tension", the desire of other states to implement their geopolitical plans and unresolved social problems. In addition, the state is the main institution*

that creates appropriate conditions for the functioning of each business entity. In Ukraine, there is a need to define the benchmarks of the security system, study international experience and implement it in the process of improving national security legislation. The article examines and analyzes the theoretical foundations of the state management of national security development, reveals the essence of such concepts as "national security", "economic security"; identifies the components of national and economic security of Ukraine; mechanisms of state management of economic security; characterizes three main types of security threats, namely: external and internal; real and potential; global, regional and local; identifies threats affecting economic security; develops recommendations for improving the effectiveness of the state management of economic security.

***Keywords**:* national security, economic security, mechanism, public administration, society, external and internal threats

Микола Андрієнко, Петро Гаман, Богдан Овчаренко, Павло Гордєєв «Основні напрями забезпечення національної безпеки та механізми державного управління в умовах військового стану». *Завдання забезпечення національної безпеки на даний момент для України є ключовим, як умова та мета проведення реформування в усіх сферах державної та суспільної діяльності. Зміст перетворень в цій сфері має бути пов'язаний із забезпеченням та всебічним укріпленням суверенітету України, збереженням її територіальної цілісності. Ситуація, що складається в світі нині характеризується наявністю "точок напруження", бажанням інших держав реалізувати свої геополітичні плани та невирішеними соціальними проблемами. Крім того, держава є основною інституцією, яка створює відповідні умови для функціонування кожного суб'єкта господарювання. В Україні назріла необхідність визначити орієнтири системи безпеки, вивчити міжнародний досвід та реалізувати його в процесі удосконалення законодавства щодо національної безпеки. У статті розглянуто та проаналізовано теоретичні основи державного управління розвитком національної безпеки, розкрито сутність таких понять як "національна безпека", "економічна безпека"; визначені складові національної та економічної безпеки України; механізми державного управління економічною безпекою, охарактеризовані три основні види загроз безпеці, а саме: зовнішні та внутрішні; реальні і потенційні; глобальні, регіональні та локальні; виявлені загрози, які впливають на економічну безпеку; розроблені рекомендації щодо підвищення ефективності впроваджених заходів та мінімізації наявних загроз.*

Ключові слова: національна безпека, економічна безпека, механізм, державне управління, суспільство, зовнішні та внутрішні загрози

Introduction. In today's globalized world, every country strives for economic independence. In particular, to achieve this result, the issue of the theoretical foundations of public administration of national security development, determining the role and place of economic security in the overall system of public administration mechanisms for ensuring national security of Ukraine is important. In today's realities, we can see a tendency for threatening factors to influence the activities of the state. In the future, this may lead to a decrease in the level of economic security of Ukraine, which in turn will significantly affect the national security of the country as a whole. In addition, the effectiveness of ensuring national security directly depends on the state of the state's economy, since the realization of national interests is largely conditioned by the availability of appropriate economic opportunities. In Ukraine, in the context of reforms in all spheres of life, the issue of national security and the mechanism for ensuring it is one of the key ones. The complicated domestic political and economic situation, the spread of international terrorism, and the growing threats to the

interests of citizens, society, and the state require the development of effective measures aimed at ensuring national security.

Analysis of recent research and publications. One of the main mechanisms of state policy that determine the ways of ensuring the national security of the state is the organizational and legal mechanisms. The organizational mechanism of the state policy ensures coordination of the activities of the authorities, creation of the necessary structures in the system of ensuring national security, initiation and holding of public discussions on national security issues, and the legal mechanism has a legislative approach, which is revealed through ensuring national security by adopting new legislative norms and their implementation through various forms of state control.

The essence of the mechanisms of state policy proposed by scholars, in particular, such as I. Binko, S. Holovashchenko, O. Danilian, O. Dzoban, A. Kachynskyi, N. Nyzhnyk, H. Sytnyk and others, is to implement mechanisms of state policy to ensure national security, to coordinate the activities of the authorities in this area.

The formulation of the goals of the article is analysis of the main directions of ensuring national security and mechanisms of public administration under martial law.

Presentation of the main results. The effectiveness of ensuring national security directly depends on the state of the state's economy, since the realization of national interests is largely conditioned by the availability of appropriate economic opportunities. In Ukraine, in the context of reforms in all spheres of life, the issue of national security and the mechanism for ensuring it is one of the key ones. The complicated domestic political and economic situation, the spread of international terrorism, and the growing threats to the interests of citizens, society, and the state require the development of effective measures aimed at ensuring national security.

The strategic goal of ensuring national security in the sphere of state and public security is determined by the national interests of Ukraine in the domestic political sphere, which include the preservation of the constitutional order, maintenance of civil and national harmony, and unity of the legal space [1, 2].

Based on a detailed analysis of regulatory and legal documents, it is advisable to group the main factors that influence the state of the USCS and its development in the current and medium-term perspective. After all, in general, the challenges and threats that characterize the modern security environment can be grouped into two groups of factors - external (foreign policy, military, environmental and other) and internal (internal political, socio-economic, man-made, natural and other) [3].

Let us consider in more detail these groups of factors and their impact on the state and development of the state civil protection system in the current and projected security environment:

1) External (foreign policy, military, environmental, etc.):

- Changes in the geopolitical situation in the world that caused the crisis of the international security system, increase in the number and scale of terrorist attacks during political and armed struggle;

- an increase in the number of local military conflicts with the threat of their escalation into large-scale wars, the continued probability of the use of weapons of mass destruction (chemical, nuclear, etc.) and their components in modern armed conflicts;

- further changes in the peculiarities of armed struggle (priority use of high-precision weapons, improvement of modern means of destruction, creation of weapons based on new principles of destruction, etc;)

- transformation of the mechanism of emergence and development of modern military-political conflicts (increasing the role of indirect (non-military) actions against the enemy: political, diplomatic, economic, environmental, information and

psychological operations and other forms of active influence);

- use of forms and methods of "hybrid warfare" against Ukraine;

- global climate change and deterioration of the planet's environment, resulting in large-scale natural disasters, environmental catastrophes, growing water and food shortages, etc;

- the likelihood of biological threats, the emergence of new human (animal, plant) diseases, in particular the COVID-19 coronavirus pandemic, is increasing [4].

2) Internal (domestic political, socio-economic, and other):

- Slowdown in the development of the state's economy, resulting in limited financial, material and technical capabilities of the country;

- transformation of the strategic priorities of Ukraine's development as a democratic state (restructuring of all institutions of the country to achieve the conditions necessary for full membership in the European Union and NATO);

- the presence of a military conflict in the east of the country, the need to eliminate its consequences, and the growth of internal migration in the country as a result of the annexation of territories;

- improvement of the public administration system by reforming local self-government and territorial organization of power in Ukraine;

- a decrease in the level of industrial and technogenic safety due to the deterioration of industrial and transport infrastructure, high-risk facilities;

- preservation of the trend of large-scale natural emergencies (natural hazards, floods, etc.) on the territory of the state [5].

The armed aggression of the Russian Federation, which continues the war and systematically uses political, economic, information and psychological, cyber and military means, is a permanent threat to the security of our state [6]. Therefore, the system of ensuring national security should include a set of measures and activities of security actors to implement them in order to ensure reliable and stable functioning of social relations in the state. After all, the content of actions in a modern military-political conflict is not so much the physical destruction of the enemy's armed forces, but demoralization and imposition of the aggressor's will on the entire population of the state through the use of a wide range of military and non-military instruments.

Conclusions. Thus, in modern military-political conflicts, civilians are one of the main objects of the enemy's so-called "attention": they not only bear the main physical burden of the consequences of armed confrontation, but also are under enormous pressure from ideological, economic, informational, psychological and other components of this military-political conflict.

The above-mentioned threats give grounds for increased attention of the state authorities in the course of improving the USCPS to ensure its readiness and capability to fulfill the tasks of protecting the population and territories from the consequences of military conflicts in a special period, and to eliminate the consequences of emergencies related to the use of conventional means of destruction and weapons of mass destruction or their components.

Ensuring security should be considered one of the most important national priorities that will help overcome the difficulties of the transition period and start economic recovery, provide access to global economic relations and, at the same time, guarantee the protection of national interests in the field of internal and external relations. Ensuring national security is a long-term and strategic task. Its solution involves the development of the concept of state security and the approval of the state security strategy, as well as the implementation of policies aimed at their realization. National security is ensured at each level by appropriate structures and methods.

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UDC 658
DOI: https://doi.org/10.46783/smart-scm/2024-24-9
JEL Classification: M10, G32, H12.
Received: 18 March 2024

Fedorenko Tetiana. PhD (Law), associate professor, associate professor of the Department of industry law and general legal disciplines, Director of the Institute of Law and Public Relations, Open International University of Human Development «Ukraine» (Ukraine)

ORCID – 0000-0002-3447-9078
Researcher ID – IXW-8334-2023
Scopus author id: – 57208330545

Zahorodnia Alona. PhD (Management), senior lecturer of Department of logistics, National Aviation University (Ukraine)

ORCID – 0000-0003-2741-1953
Researcher ID –
Scopus author id: – 57822517200

Koval Yana. PhD (Public administration), associate professor, associate professor of international management Department, State University of Trade and Economics (Ukraine)

ORCID – 0000-0001-6578-2996
Researcher ID – U-9357-2018
Scopus author id: – 57221940751

INFORMATION AND ANALYTICAL ACTIVITY IN THE SYSTEM OF ECONOMIC SECURITY OF THE ENTERPRISE

Tetiana Fedorenko, Alona Zahorodnia, Yana Koval. "Information and analytical activity in the system of economic security of the enterprise". *This article is devoted to understanding the importance of information and analytical support for management decisions in modern conditions, when there are threats of various nature. It has been proven that the selection of reliable necessary information, scientifically based methods of its analysis provide optimal solutions in these conditions, aimed at ensuring the effective operation of the enterprise. Analysis occupies an intermediate place between the selection of information and decision-making.*

It has been studied that depending on business conditions, different decisions are made, different techniques and methods of analysis are used. The main features that determine the content of analytical activity are highlighted, such as: the study of economic phenomena, objective assessment of the efficiency of the enterprise, scientific substantiation of business plans and identification of reserves at the enterprise. The main tasks of the information and analytical system of enterprises of network structures in modern conditions are highlighted.

It is considered that the object of analysis is the economic activity of the enterprise, which can be divided into economic processes and financial results formed under the influence of objective and subjective factors.

Keywords*:* information and analytical activity, provision, economic security, economic security system, enterprise, information, analysis, methods

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Альона Загородня, Яна Коваль. «Інформаційно-аналітична діяльність в системі економічної безпеки підприємства». *Ця стаття присвячена розумінню важливості інформаційно-аналітичного забезпечення управлінських рішень у сучасних умовах, коли існують загрози різного характеру. Доведено, що вибір достовірної необхідної інформації, науково обґрунтовані методи її аналізу забезпечують оптимальні рішення в цих умовах, що спрямовані на забезпечення ефективної діяльності підприємства. Аналіз займає проміжне місце між вибором інформації та прийняттям рішень.*

Досліджено, що залежно від умов бізнесу приймаються різні рішення, використовуються різні техніки та методи аналізу. Виділено основні риси, які визначають зміст аналітичної діяльності, такі як: вивчення економічних явищ, об'єктивна оцінка ефективності діяльності підприємства, наукове обґрунтування бізнес-планів та виявлення резервів на підприємстві. Виділено основні завдання інформаційно-аналітичної системи підприємств мережевих структур в сучасних умовах.

Розглянуто, що об'єктом аналізу є економічна діяльність підприємства, яку можна поділити на економічні процеси та фінансові результати, сформовані під впливом об'єктивних та суб'єктивних факторів.

Ключові слова: інформаційно-аналітична діяльність, забезпечення, економічна безпека, система економічної безпеки, підприємство, інформація, аналіз, методи

Introduction. Modern Ukrainian enterprises have to carry out their market activities in conditions of high uncertainty of the processes taking place both in the national and global economy) In order to successfully counteract threat factors and ensure stable operation and development of the enterprise, it is necessary to have an effective system of economic security).

Modern forms of managing economic activity include a multifunctional system for assessing threats and risks at an enterprise, which in turn creates the need to improve the methods and tools for information and analytical support of economic security of enterprises. The problem of optimization of the relevant methods and tools is at the intersection of such scientific areas as financial analysis and statistics.

Analysis of recent research and publications. The issue of information and analytical support for economic security was considered by leading domestic and foreign scholars, such as: R. Babaev, I. Belousova, N. Bondarchuk S. Ilyashenko, L. Hrechaniuk, I. Mihus, S. Philippova, A. Pravdiuk, N. Reznik, T. Suhak, and others. However, the issues of information and analytical activities in the system of economic security of an enterprise are not sufficiently considered and require further research.

The formulation of the goals of the article is to optimize the management of economic security in the process of information and analytical support of economic security of the enterprise.

Presentation of the main results. We would like to draw your attention to the fact that modern transformation systems lead to an increase in the role of information and analytical support of the system of enterprises of network structures, which require the development and application of new methods [8].

It is important for the management of each organization to develop an individual mode of working with information, especially at the stage of its accumulation and analysis. Only a detailed and step-by-step definition of the process of working with information resources of various departments and officials increases the effectiveness of organizational support for the economic security of the enterprise. The quality of analytical support is the basis for building an effective system of

economic security of an enterprise and one of the key factors of its development [3].

Modern times impose specific conditions on the economic security of an enterprise, especially given the expanding role and amount of information available. The information array that is freely available is constantly being updated, which requires decision makers to search for new methods of information processing.

The essence of the analysis is information and analytical support of management decisions in the conditions of existence of threats of various etymologies.

The selection of reliable necessary information, scientifically substantiated methods of analyzing this information provide optimal decisions in these conditions, focused on ensuring the effective operation of the company. Analysis takes an intermediate place between the selection of information and decision-making.

Depending on the business conditions, different decisions are made, different techniques and methods of analysis are used. We can distinguish the main features that determine the content of analytical activity:

– the study of economic phenomena, and the reasons that caused them, and representing, in fact, the factors that form both threats to the safe functioning of the company, and advantages (provided that they are "correctly" embodied;

– objective assessment of the efficiency of business activities (threats of internal origin);

– scientific substantiation of business plans, control of their fulfillment;

– identification of on-farm reserves, study and generalization of specific experience [2].

The object of analysis is the economic activity of the enterprise, which can be divided into economic processes and financial results, formed under the influence of objective and subjective factors and reflected through the system of technical and economic information and included in the system of economic security of the company.

For this purpose, according to the data of the reporting information, the past activity is evaluated and the position of the enterprise at the time of analysis is determined, and also the future potential of the enterprise is evaluated, i.e. the forecast of further development. The result of such an analysis should be the development of directions for qualitative improvement of economic activity for the purpose of safe operation of the enterprise.

There are two approaches to collecting and processing information. The first is quantitative research based on descriptive surveys aimed at strict standardization and formalization of the process of information collection and processing, which enable the company to obtain accurate data on the audience under study, expressed in absolute or relative values. As a rule, the survey technique is the main one in quantitative research. But there are a number of other methods such as hall tests and home tests, which are included in the variants of experiments, test trials [7].

The second approach is qualitative research, which is an in formalized collection of data using field methods and non-standardized form of their analysis, which allows obtaining detailed information about the psychology of the consumer, his values, worldview, underlying motives of behavior, as well as data that respondents consciously or unconsciously can not or do not want to provide to the researcher.

According to the content of the management process there are operational, current (retrospective), prospective types of analysis.

Operational analysis is a system of daily study of the fulfillment of planned tasks in order to quickly intervene in necessary cases in the process of economic activity to ensure continuous and effective functioning of the economic complex [6].

Current analysis is a system of periodic, comprehensive study of the results of economic activity for a certain period. It allows to evaluate the work of enterprises and

their departments, to identify shortcomings and their causes, internal production reserves, mobilization of them to improve the efficiency of economic activity in subsequent periods.

Prospective (forecast) analysis studies phenomena and processes from the perspective of the future, i.e. the prospects of their development. The most important tasks include forecasting of economic activity, scientific justification of current and prospective plans for socio-economic development, assessment of the realism of planned decisions, their compliance with the internal logic of economic development, assessment of the expected implementation of plans [4].

Stages of analysis:

1. Preliminary study of the subject of analysis, drawing up its economic model. The purpose of the stage is to establish internal and external relations of the subject of analysis, to determine the nature of processes and their dependence on different factors.

2. Detailing of factors, establishing the direction of action and relative strength of influence of each group of factors.

3. Quantitatively determine the impact of individual factors (groups of factors) on the dynamics of development, performance, to identify the essential and decisive factors. The most difficult and responsible stage of analytical research is a scientifically justified grouping of factors and the development of a system of indicators characterizing the state, dynamics of development and performance of the subject under study. The value of measurement lies in the combination of qualitative and quantitative characteristics of the object of analysis, which gives a clear picture of the results of its activities.

4. Generalization of the results of the analysis includes conclusions containing an assessment of this activity, a summary of reserves and recommendations for their use. The task of the analysis is to make a general, integral picture of the process from various kinds of data, sometimes scattered, reflecting separate phenomena and facts, to identify inherent trends and regularities and to make the right optimal decision if possible [5].

Analysis of the economic entity's activity contains three objects: analysis of the accounting system, analysis of the management system, analysis of the production and sales system.

The function of the accounting system is to create conditions for information support of control of the necessary intensity of production and realization of products. The accounting system meets the requirements to the extent that it reliably allows to control the fulfillment of norms by employees, the course of the process of production and realization of products, to create an information base for making managerial decisions [1].

The function of the management system is to develop management decisions on the effective development of the organization. Therefore, the purpose of this analysis is to determine the ability of the management system to develop such management decisions. The quality of the management system is expressed in the selection of persons of the top management of the organization.

The purpose of the analysis of the production and sales system is to quantify the probability of effective operation of the enterprise in the future. The analysis is designed to solve the problems of rational consumption of resources during the manufacture and realization of products [11].

The choice of the analysis approach specifies the purpose of the analysis:

– comparison of the indicators of the enterprise with the norms, with the average indicators of the world market economy, with the indicators of competitors allows us to assess the level of development of the enterprise, its competitiveness;

– comparison of the enterprise data in time allows to evaluate the development of the enterprise in dynamics, to make a forecast of future potential, which is important for assessing the value of the enterprise [9].

As for analyzing the economic security of the enterprise, the following methods can be distinguished:

– Cyclic – based on the theory of economic cycles (long, medium and short waves of economic development). At the junction of waves there are threats to economic security. The realization of threats takes place at the transition to a new cycle of economic development or at the loss of competitiveness;

– Systemic – with this method economic security is determined by a set of elements that make up its structure. These elements include: personnel, production, financial investment, organizational, intellectual and scientific-technical potential;

– Infrastructural (cluster) – economic security at the expense of certain factors achieves specified goals (level of product quality, solvency, cost reduction, etc.);

– Process – when assessing the methods of analyzing the dynamics of indicators, economic security is monitored. This method characterizes the level of economic security as a synergistic effect. Thanks to this effect, it is possible to respond to threats to economic security in time.

It should be noted that in combination with each other, these methods represent a powerful system for analyzing and forecasting the risks of the enterprise in the field of economic security, since all possible internal and external factors affecting the enterprise are taken into account [10].

Conclusions. Thus, information and analytical activities in the system of economic security of the enterprise include three objects: analysis of the accounting system, analysis of the management system, and analysis of the production and sales system. Each of these aspects is important for ensuring the efficient operation of the enterprise and its economic security.

To ensure effective management of the economic security of an enterprise, various methods are used, such as cyclical, systemic, infrastructure and process, which together create a powerful system for analyzing and forecasting the risks of an enterprise in the field of economic security, since all possible internal and external factors affecting the enterprise as a whole are taken into account.

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v.24 (2024)
https://smart-scm.org

UDC 330.1:658.7:658.8:004
JEL Classification: L50, L86.
Received: 21 March 2024
DOI: https://doi.org/10.46783/smart-scm/2024-24-10

Harmash O.M. PhD (Economics), Associate Professor, Associate Professor at the Logistics Department, National Aviation University (Ukraine)

ORCID – 0000-0003-4324-4411
Researcher ID – I-4542-2018
Scopus author id: – 57218381499

Hubarieva I.O., Doctor of Sciences (Economics), Professor, Research Center for Industrial Problems of Development of NAS of Ukraine (Ukraine)

ORCID – 0000-0002-9002-5564
Researcher ID –
Scopus author id: – 57190439486

Harmash T.A., PhD (Pedagogics), Associate Professor, Associate Professor of the Department of Foreign Languages and Translation, National Aviation University (Ukraine)

ORCID – 0000-0001-6691-4815
Researcher ID – B-4022-2019
Scopus author id: – 57216355023

Trushkina N.V., Ph.D. (in Economics), Senior Researcher Research Center for Industrial Problems of Development of the NAS of Ukraine (Ukraine)

ORCID – 0000-0002-6741-7738
Researcher ID – C-1441-2018
Scopus author id: – 57210808778

RELATIONSHIP BETWEEN THE CONCEPTS OF "DIGITAL TRANSFORMATION" AND "INDUSTRY 5.0": BIBLIOMETRIC ANALYSIS

Harmash Oleh, Hubarieva Iryna, Harmash Tetiana, Trushkina Nataliia. "Relationship between the concepts of "Digital transformation" and "Industry 5.0": bibliometric analysis". *At the current stage of transformational transformations, the problems of transformation of the national economy are extremely relevant. And these questions are especially relevant in the conditions of rapid development of the digital economy. According to estimates by Forbes experts, 67% of the leaders of companies from the Global 2000 list chose digital transformation as a priority goal of their corporate strategy in 2018. According to a study by analysts International Data Corporation, the total global spending on digital technologies will grow by 16.8% annually and amounted to 2.1 trillion dollars in 2019. Research by Huawei and Oxford Economics has shown that intelligent network interaction will trigger the growth of the digital economy, which will reach 23 trillion dollars by 2025. This increase will be 78.3% compared to 2017 (12.9 trillion dollars). By 2025, the share of the*

digital economy is planned to increase by 7.2 percentage points, or from 17.1 to 24.3% of global GDP. According to the calculations of The Boston Consulting Group experts, the volume of the digital economy by 2035 will amount to 16 trillion dollars USA.

In view of this, the purpose of this study is to determine the trends and key directions of digital transformation research in the era of Industry 5.0 based on bibliometric analysis using the VOSviewer software. The article carries out a bibliometric analysis of the relationship between the terms "digital transformation", "digitalization","Industry 4.0", "Industry 5.0". It has been established that currently the problems of the digital transformation of the economy in the context of the implementation of the digital strategy of the European Union are gaining special relevance. Digital transformation is a key component of the overall strategy to transform the global economy. Correctly selected digital technologies combined with employee competencies, processes and operations will allow companies to quickly adapt to crisis situations, use promising opportunities to modernize work processes, meet new and constantly changing customer needs, stimulate growth and implement innovative and management solutions.

The concept of digital transformation of the national economy in the context of Industry 5.0 should involve the use of digital tools and platforms to transform traditional business processes, improve interaction with customers, introduce innovative technologies and form a digital ecosystem. The main components of the digital transformation of critical infrastructure include: digital technologies (cloud computing, artificial intelligence, big data analytics and the Internet of Things (IoT); organizational changes (restructuring of processes to increase their flexibility, introduction of new methodologies (DevOps, Agile), formation of a digital culture); customer orientation and integration of digital channels.

For effective digital transformation of the economy on a practical level, it is advisable to pay attention to such main aspects as: having a clear vision and strategy that meets business goals; involving different groups of stakeholders and ensuring the interest of the entire organization; constant monitoring and evaluation of the implementation of digital transformation initiatives; an adaptive and iterative approach that allows you to navigate the changing digital landscape. It has been proven that the priority direction of research in the future should be the substantiation of the theoretical and methodological provisions of the formation of the digital ecosystem.

***Keywords**:* Industry 4.0, Industry 5.0, digital economy, digital transformation, digitization, digital ecosystem, digital innovation, digital technologies, information systems, digital space, artificial intelligence, sustainable development, efficiency, sustainability

Гармаш Олег, Губарєва Ірина, Гармаш Тетяна, Трушкіна Наталія. "Взаємозв'язок понять «Цифрова трансформація» та «Промисловість 5.0»: бібліометричний аналіз". *На сучасному етапі трансформаційних перетворень проблеми трансформації національної економіки є надзвичайно актуальними. Ці питання особливо актуальні в умовах швидкого розвитку цифрової економіки. За оцінками експертів Forbes, у 2018 році 67% лідерів компаній зі списку Global 2000 обрали цифрову трансформацію як пріоритетну мету своєї корпоративної стратегії. Згідно з дослідженням аналітиків International Data Corporation, загальні глобальні витрати на цифрові технології у 2019 році зросли на 16,8% і становили 2,1 трільйона доларів. Дослідження Huawei і Oxford Economics показали, що інтелектуальна мережева взаємодія сприятиме росту цифрової економіки, яка досягне 23 трільйонів доларів до 2025 року. Це зростання складе 78,3% у порівнянні з 2017 роком (12,9 трільйона доларів). До 2025 року планується збільшення частки цифрової економіки на 7,2 відсоткових пункти, або від 17,1 до 24,3% від загального ВВП світу. За розрахунками експертів компанії The Boston Consulting Group, обсяг цифрової економіки до 2035 року складатиме 16 трільйонів доларів США.*

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З огляду на це, мета дослідження полягає у визначенні тенденцій та ключових напрямів досліджень цифрової трансформації в епоху Промисловості 5.0 на основі бібліометричного аналізу з використанням програмного забезпечення VOSviewer. У статті проводиться бібліометричний аналіз взаємозв'язку термінів «цифрова трансформація», «цифровизація», «Промисловість 4.0», «Промисловість 5.0». Встановлено, що наразі проблеми цифрової трансформації економіки в контексті реалізації цифрової стратегії Європейського Союзу набувають особливої актуальності. Цифрова трансформація є ключовою складовою загальної стратегії трансформації глобальної економіки. Правильно підібрані цифрові технології, поєднані з компетенціями співробітників, процесами та операціями, дозволять компаніям швидко адаптуватися до кризових ситуацій, використовувати перспективні можливості для модернізації робочих процесів, відповідати новим потребам клієнтів,які постійно змінюються, стимулювати зростання та реалізовувати інноваційні й управлінські рішення.

Концепція цифрової трансформації національної економіки в контексті Промисловості 5.0 повинна передбачати використання цифрових інструментів та платформ для трансформації традиційних бізнес-процесів, покращення взаємодії з клієнтами, впровадження інноваційних технологій та формування цифрової екосистеми. Основні складові цифрової трансформації критичної інфраструктури включають: цифрові технології (хмарні обчислення, штучний інтелект, аналітика великих даних та Інтернет речей); організаційні зміни (перебудова процесів для підвищення їх гнучкості, впровадження нових методологій (DevOps, Agile), формування цифрової культури); спрямованість на клієнта та інтеграція цифрових каналів.

Для ефективної цифрової трансформації економіки на практичному рівні доцільно звернути увагу на такі основні аспекти, як: наявність чіткої візії та стратегії, яка відповідає бізнес-цілям; залучення різних груп зацікавлених сторін та забезпечення інтересу всієї організації; постійний моніторинг та оцінка реалізації ініціатив цифрової трансформації; адаптивний та ітеративний підхід, що дозволяє орієнтуватися в змінному цифровому ландшафті. Доведено, що пріоритетним напрямком досліджень у майбутньому повинно бути обґрунтування теоретичних та методологічних положень формування цифрової екосистеми.

Ключові слова: Промисловість 4.0, Промисловість 5.0, цифрова економіка, цифрова трансформація, цифровизація, цифрова екосистема, цифрові інновації, цифрові технології, інформаційні системи, цифровий простір, штучний інтелект, сталий розвиток, ефективність, стійкість.

Introduction. During the first of the four industrial revolutions, steam power became the technology that changed the world. During the second it was a conveyor, and during the third – a computer. Today, the global world is witnessing a rapid transition to information and communication technologies. This, in turn, will contribute to the acceleration of the processes of digitalization of the development of ecosystems in the era of the fourth industrial revolution, the engine of which is digital technologies [1-2]. Artificial intelligence, machine learning, Internet of Things networks, advanced analytics, and robotics allow us to rethink the way we work and do business, as well as the way companies interact with their customers and the world.

Digital transformation is recognized as a key component of the overall business transformation strategy. Correctly selected technologies in combination with the competencies of employees, processes and operations allow organizations to quickly adapt to complex situations, use promising opportunities, meet new customer needs [3-4] that are changing, stimulate growth and introduce innovations. Digital transformation involves the integration of digital technologies and solutions in all spheres of

economic activity. This is a cultural and technological change that requires organizations to fundamentally transform their work methods, as well as customer experience and benefits. Digital solutions help to expand the staff and can lead to the transformation of business processes and business models [5].

It should be noted that companies need to evolve and transform their digital landscape, starting with raw materials and early levels of the supply chain, to meet rapidly changing customer needs for more personalized service and order fulfilment, as well as to modernize and innovate traditional business models. By 2018, more than 89% of executives have implemented business policies in their companies that are primarily focused on digital technologies. By 2021, this figure has grown even more. However, during the implementation of many digital transformation projects, there were difficulties and problems in communication and planning.

According to the results of a survey conducted by the consulting company McKinsey in 2021, it was established that after COVID-19, top managers feel an urgent need to digitize and modernize work processes and outdated systems. Many respondents admit that their companies' business models are outdated. Only 11% of respondents believe that current business models will remain economically viable until 2023. Another 64% say that their companies need to form a digital business in order not to disappear.

So, fundamental innovations and radical transformations in the digital information field allow us to talk about the formation of a new economic reality of the XXI century. – Industries 5.0. The digital era is moving from the space of Industry 4.0 to the space of Industry 5.0 with qualitatively different properties. In the space of "Industry 5.0", the classic firm ceases to be a key player in economic reality, giving way to a new economic entity – the digital ecosystem. In view of this, there is currently a need to form a qualitatively new concept of digital transformation of the national economy in the context of Industry 5.0.

Literature and researches review. The analysis of scientific literature shows that leading scientists (E. Brynjolfsson, B. Kahin [6]; C. Dahlman [7]; W. Drozdz et al. [8]; H. Dzwigol et al. [9]; T. Elmasry et al. [10]; A. Kwilinski [11-13]; N. Lane [14]; F. Machlup [15]; R. Miśkiewicz [16]; D. Tapscott [17]; A. Tugui [18]) pay considerable attention to the study of new forms of digital transformation of the economy, to the development of digital models and strategies.

Despite the wide range of scientific research on the chosen topic, the multifacetedness and debatable nature of certain issues require further development. And especially the solution to this problem is actualized at the current stage of changing strategic thinking and the concept of transformation and modernization of the national economy in the conditions of digital transformations.

Aim and objectives. The purpose of this research is to identify the relationship between the terms "digital transformation" and "Industry 5.0" based on the bibliometric analysis of scientific publications.

The theoretical and methodological basis of the research is the provisions of the institutional theory; theory of systems, management, information society, network economy, digital economy; concepts of strategic management.

The following general scientific methods were used in the research process: analysis and synthesis, comparison and classification, expert survey, structural and logical generalization.

Results, analysis and discussion. The fourth industrial revolution – the concept of Industry 4.0 – is based on intelligent technologies. It consists of the following most important elements: additional production; augmented reality; autonomous robots; big data and analytics; cloud connection; cybersecurity; horizontal and vertical integration of systems; Internet of things; simulations and digital doppelgangers.

At the same time, it should be emphasized that Industry 5.0 is not considered another industrial revolution, but rather as a complement to the technologies of Industry 4.0 due to the strengthening of cooperation between people and robots. In Industry 5.0, the nine core components of the Industry 4.0 concept have been expanded by making creativity and human well-being the focus of the industry. This made it possible to combine the speed and efficiency of machine technology with the ingenuity and talents of personnel.

Key components of Industry 5.0 include:

- human-oriented industry puts human needs and interests at the centre of the production process. Instead of asking what workers can do with new technologies, Industry 5.0 asks what technology can do for workers. While robots are tireless and precise, they are literal and lack the critical and creative thinking of their human counterparts;

- sustainable industry helps companies reduce their impact on the environment by developing circular economy processes. Other shifts in the field of sustainable development [19-20] include reducing energy consumption, greenhouse gas emissions, and waste, as well as preventing depletion and degradation of natural resources;

- industrial production in a stable industry has a high level of reliability. It is well armed against disruptions and is able to support critical infrastructure [21] in crisis conditions. The pandemic has exposed the vulnerability of industry and the importance of increasing the flexibility and resilience of supply chains and other manufacturing components.

Based on the bibliometric analysis of scientific publications on digital transformation, which are indexed in the international scientometric database Scopus, it was established that scientists pay special attention to this issue. 61,688 documents for the years 1953-2024 were found by article title, abstracts, and keywords (Fig. 1).

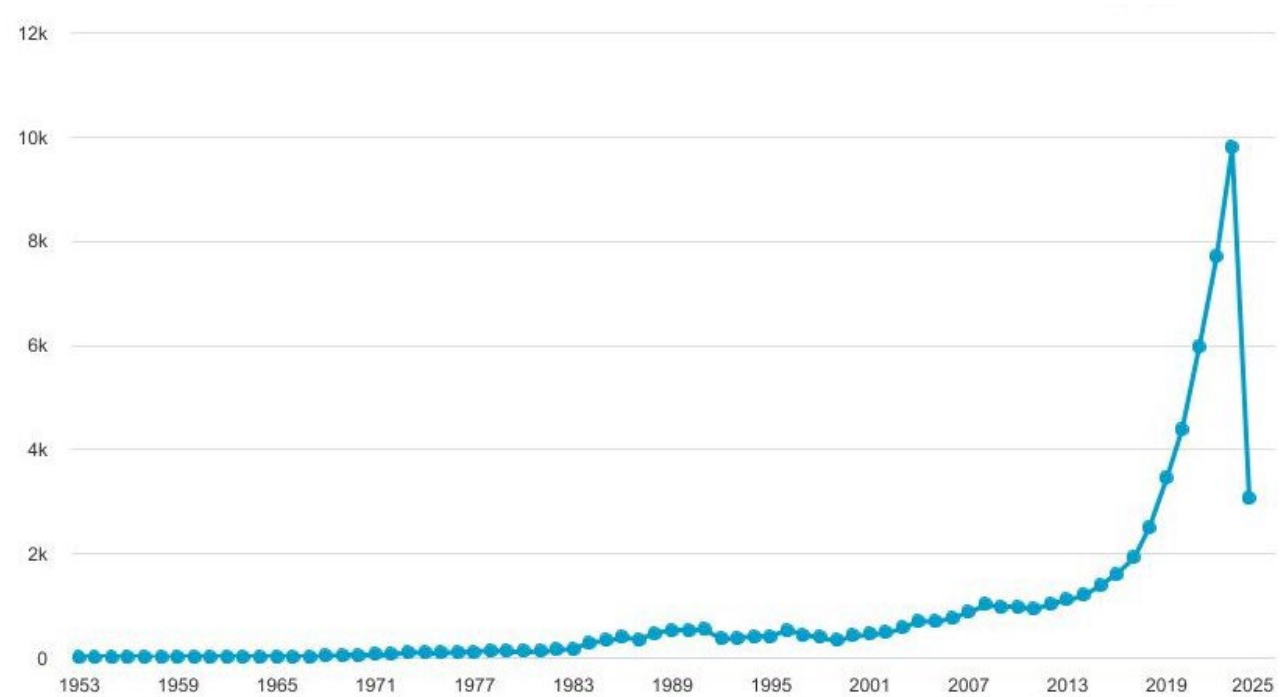

Figure 1 – Dynamics of the number of scientific publications in the scientometric database Scopus, which highlight various aspects of digital transformation

Source: built on the basis of data from the Scopus scientometric database.

As a rule, these articles use such keywords as digital transformation, digital storage, algorithms, Artificial Intelligence, Industry 4.0, digital technologies, digitalization, decision making, Big Data, Internet of Things, information management, sustainable development, innovation, machine learning, information systems, optimization, sustainability, blockchain, digital economy.

As the analysis shows, scientists have been studying the problems of Industry 4.0 since 1928. Based on the title of the articles, abstracts and keywords, 5,640 documents were found for the years 1928-2024, in which the principles and tools of the formation and development of the concepts of Industry 4.0 and 5.0 were considered (Fig. 2).

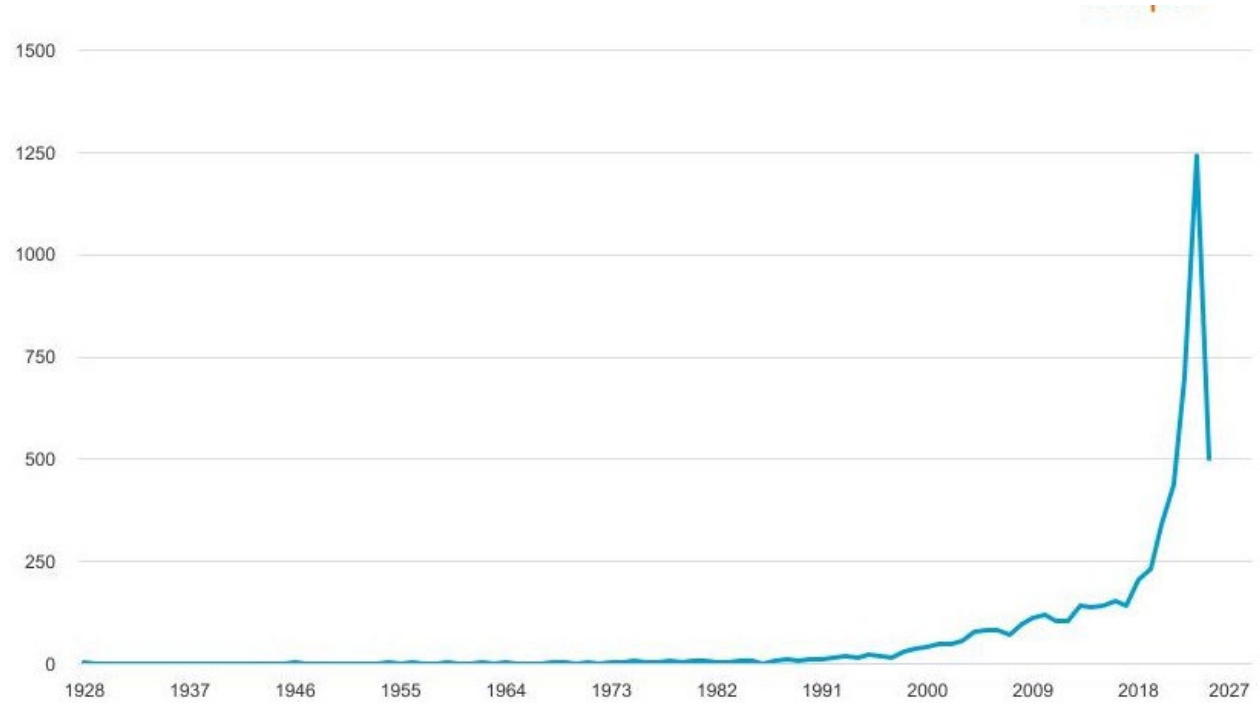

Figure 2 – Dynamics of the number of scientific publications in the scientometric database Scopus, which highlight aspects of the formation and development of Industry 4.0 and 5.0

Source: built on the basis of data from the Scopus scientometric database.

Based on bibliometric analysis, scientific publications on issues of digital transformation in the conditions of Industry 5.0 were studied. According to the title of the articles, abstracts and keywords, 227 documents were found in the international scientometric database Scopus (Fig. 3).

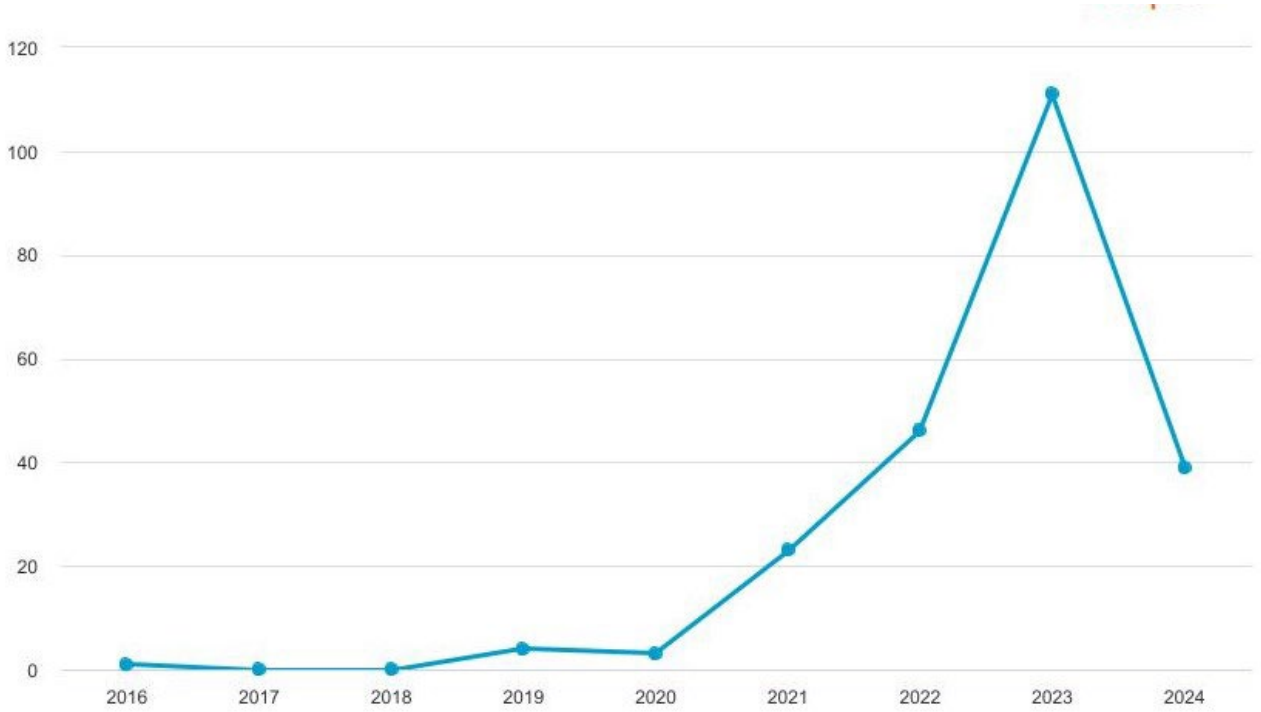

Figure 3 – Dynamics of the number of scientific publications in the scientometric database Scopus, which highlight aspects of digital transformation in the era of Industry 5.0
Source: built on the basis of data from the Scopus scientometric database.

As can be seen from fig. 3, this issue became especially relevant in the period from 2021 to 2023. The number of works increased from 23 to 111, or 4.8 times. The first publication on the selected topic appeared in the international scientometric database Scopus in 2016 [22]. The analysis shows that until 2019 there was an insignificant level of publication activity on digital transformation in the context of Industry 4.0 or 5.0. After that, the works of scientists, including L. Mihardjo et al., appeared in scientometric databases. [23], S. Nahavandi [24], L. Świątek [25], V. Roblek et al. [26], A. Lewandowska et al. [27], L. Anantharaman, M. Sridharan [28], E. Øvrelid, B. Bygstad [29], B. Hinings et al. [30] and others, in which attention is focused on the key features and problems that may arise for each manufacturer in the era of Industry 5.0; evaluating the concept of an innovative model of experience and flexibility to support modernization in the context of digital transformation aimed at Industry 5.0; considering the transition from Industry 4.0 to Nature 4.0 as a long-term evolution focused on the capacity to restore members of Society 5.0.

It is worth noting that Industry 5.0 provides a shared and automated environment, thus creating a new paradigm for companies in doing business. The way of organizing the management of resources and opportunities, especially in relations with people, the culture and the process of creating new business models have changed.

The terms artificial intelligence, cyber-physical systems, big data, industry 4.0, industry 5.0, open innovation, society 5.0, super-intelligent society have been widely used in research in recent years. The transition from Society 4.0 to Society 5.0 can be achieved by implementing knowledge and technology in IoT, robotics and big data to transform society into a smart society (Society 5.0). In particular, the concept will allow adapting services and industrial activities to the real needs of people. In addition, these technologies enable the creation of advanced platforms of digital services, which will later be integrated into all spheres of life.

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In the Table 1 shows the most cited publications that were published in scientific publications indexed by the Scopus scientometric database.

Table 1. The most cited articles on digital transformation in the context of Industry 5.0 in the scientometric database Scopus

Author(s), title of work	Year	Name of the publication	Number of Scopus citations	Number of views
Nahavandi S. Industry 5.0-a human-centric solution [24]	2019	Sustainability (Switzerland)	613	606
Carayannis E. G., Morawska-Jancelewicz J. The Futures of Europe: Society 5.0 and Industry 5.0 as Driving Forces of Future Universities [31]	2022	Journal of the Knowledge Economy	154	186
Akundi A. et al. State of Industry 5.0 – Analysis and Identification of Current Research Trends [32]	2022	Applied System Innovation	121	269
Gürdür Broo D. Kaynak O., Sait S. M. Rethinking engineering education at the age of industry 5.0 [33]	2022	Journal of Industrial Information Integration	115	328
Nair M. M., Tyagi A. K., Sreenath N. The Future with Industry 4.0 at the Core of Society 5.0: Open Issues, Future Opportunities and Challenges [34]	2021	International Conference on Computer Communication and Informatics, ICCCI 2021	94	68

Source: built on the basis of data from the Scopus scientometric database.

Among the key publications that publish works on the chosen topic, the following can be mentioned: Sustainability Switzerland (13 documents); IFIP Advances In Information And Communication Technology (11); Lecture Notes in Mechanical Engineering (7); Communications In Computer And Information Science (5); Journal Of The Knowledge Economy, Procedia Computer Science, Sensors (4 documents each).

In the Scopus database there are 6 documents of scientist E. Carayannis; 4 documents each – R. Makhachashvili, J. Pontes, I. Semenist; 3 documents each – H. Alimam, M. Bevilacqua, D. F. J. Campbell, M. Ghobakhloo, M. Iranmanesh, G. Mazzuto (Fig. 4).

The key organizations involved in solving the problems of digital transformation in the context of Industry 5.0 are The George Washington University (6 documents); Universidade do Porto, Borys Grinchenko Kyiv Metropolitan University (5 documents each); University for Continuing Education Krems, Högskolan Väst, Universidade do Minho, Universidade de Aveiro, Universidad de Sevilla, GW School of Business (4 documents each) (Fig. 5).

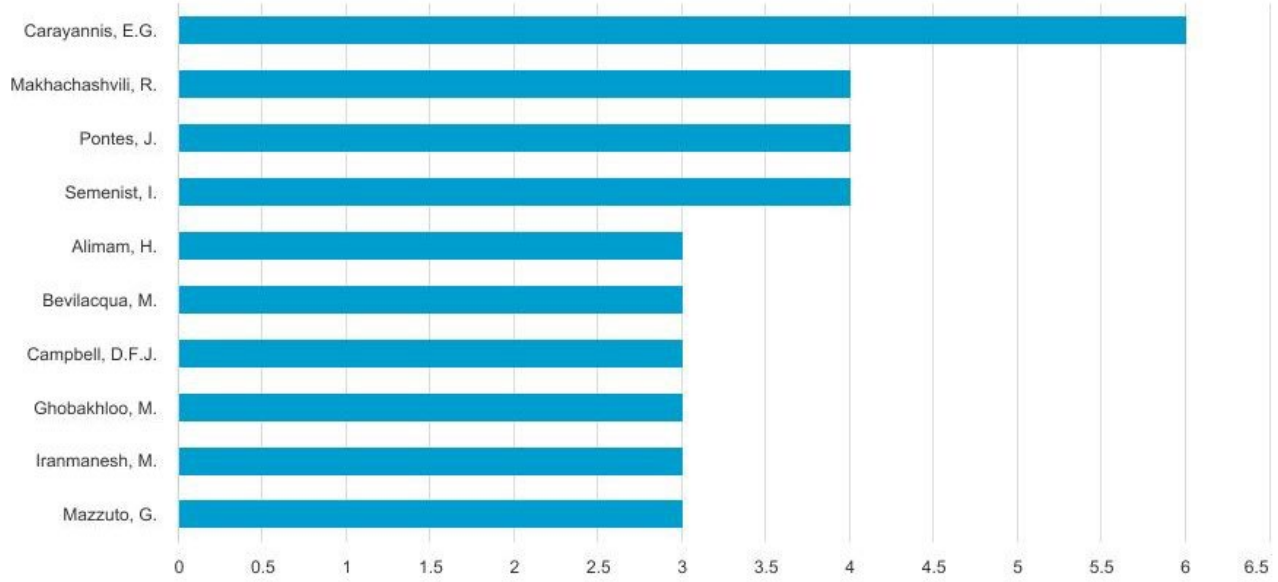

Figure 4 – Dynamics of the number of scientific publications by authors
Source: built on the basis of data from the Scopus scientometric database.

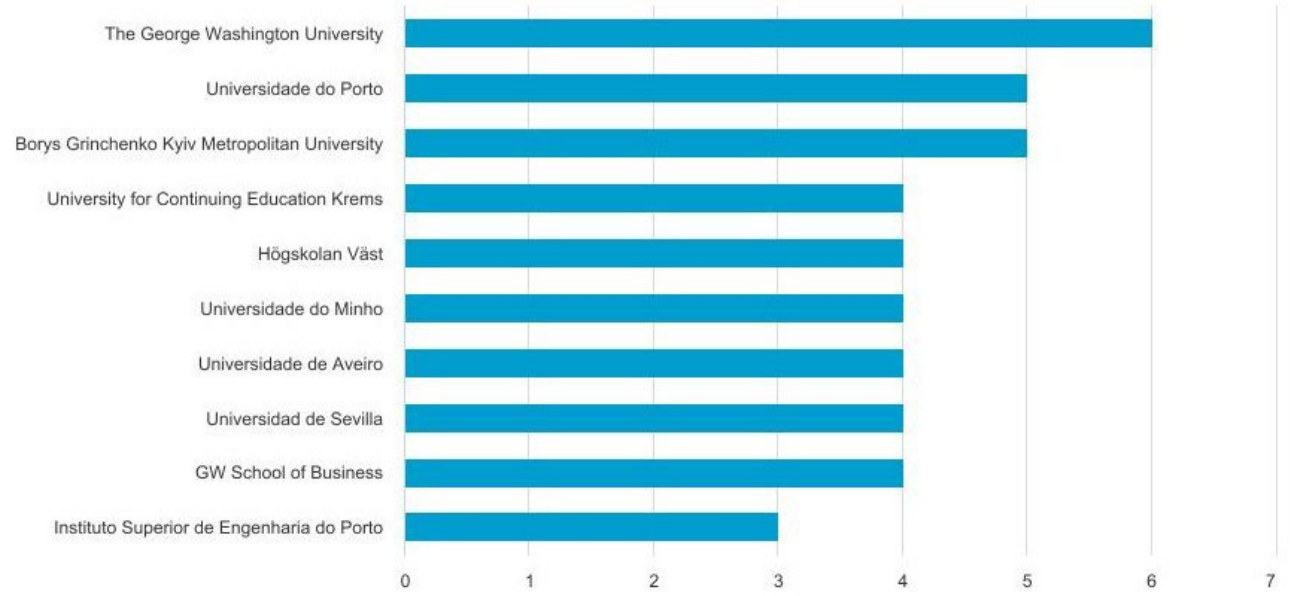

Figure 5 – Number of scientific publications by organization
Source: built on the basis of data from the Scopus scientometric database.

The results of the analysis show that most of the works on the researched issues are published by scientists from India (25 documents); Germany, Portugal (20 documents each); Turkey (17); United States (16); Italy (15); Spain (13). In Ukraine, 11 documents were found based on the established search details (Fig. 6).

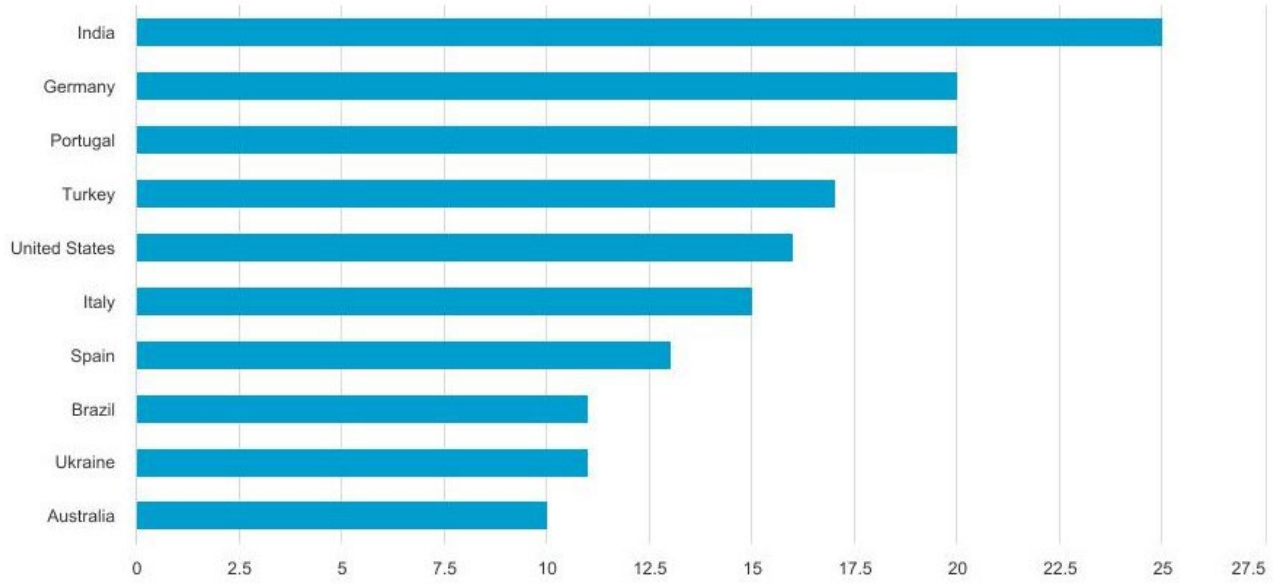

Figure 6 – Number of publications on selected issues by country
Source: built on the basis of data from the Scopus scientometric database.

According to the types of documents, scientific works can be ranked as follows: scientific articles (86), conference materials (66), sections of books or monographic publications (39), review articles (18), books (5) (Fig. 7).

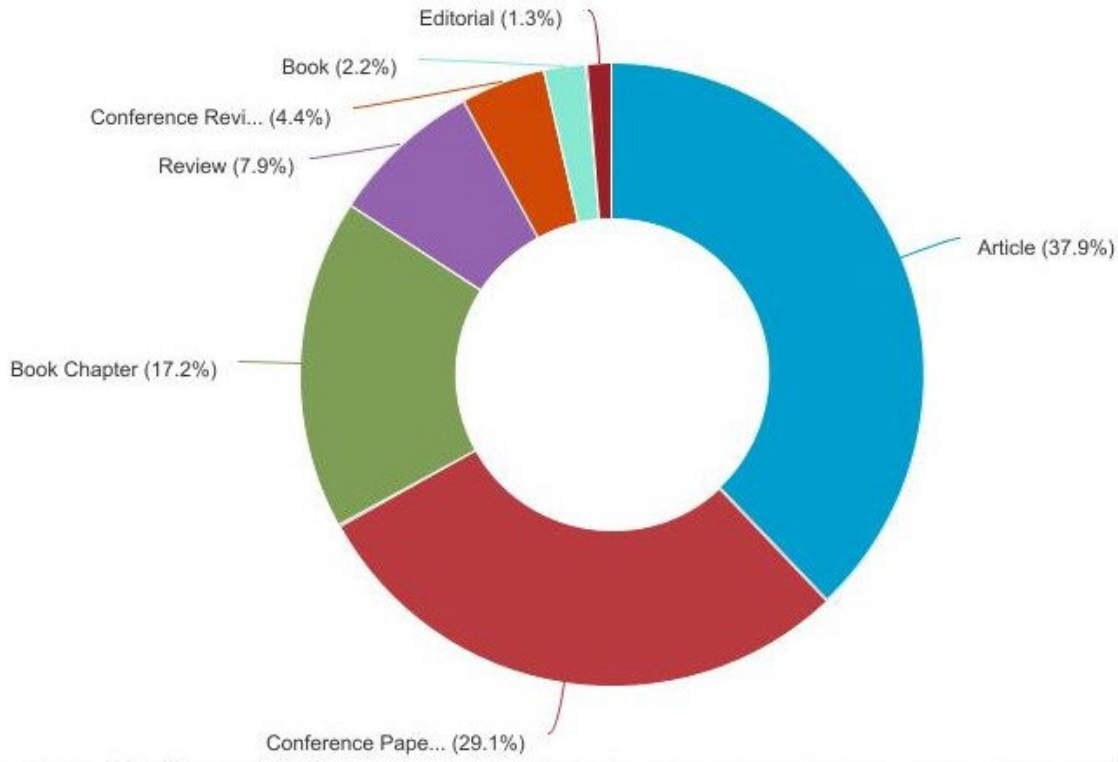

Figure 7. Specific weight of scientific publications by types of documents
Source: built on the basis of data from the Scopus scientometric database.

For the most part, scientific works on the problems of digital transformation in the conditions of Industry 5.0 are published in the following fields of knowledge: computer science (113 documents); engineering (84); business, management, accounting (64); decision-making sciences (40); social sciences (40); economics, econometrics and finance (38 documents) (Table 2).

Table 2. Number and share of scientific publications by field of knowledge

Branch of knowledge	Number of scientific publications	Share of scientific publications, %
Computer Science	113	22.1
Engineering	84	16.4
Business, Management and Accounting	64	12.5
Decision Sciences	40	7.8
Social Sciences	40	7.8
Economics, Econometrics and Finance	38	7.4
Mathematics	25	4.9
Energy	24	4.7
Environmental Science	22	4.3
Materials Science	12	2.3
Other		9.6

Source: built on the basis of data from the Scopus scientometric database.

The main sponsors that finance scientific publications on the problems of digital transformation in the era of industrial revolutions include the following: Fundação para a Ciência e a Tecnologia (14 documents); European Regional Development Fund, Horizon 2020 Framework Program, Ministério da Ciência, Tecnologia e Ensino Superior (5 documents each); Bundesministerium für Bildung und Forschung, Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, European Commission, Horizon 2020 (3 documents each) (Fig. 8).

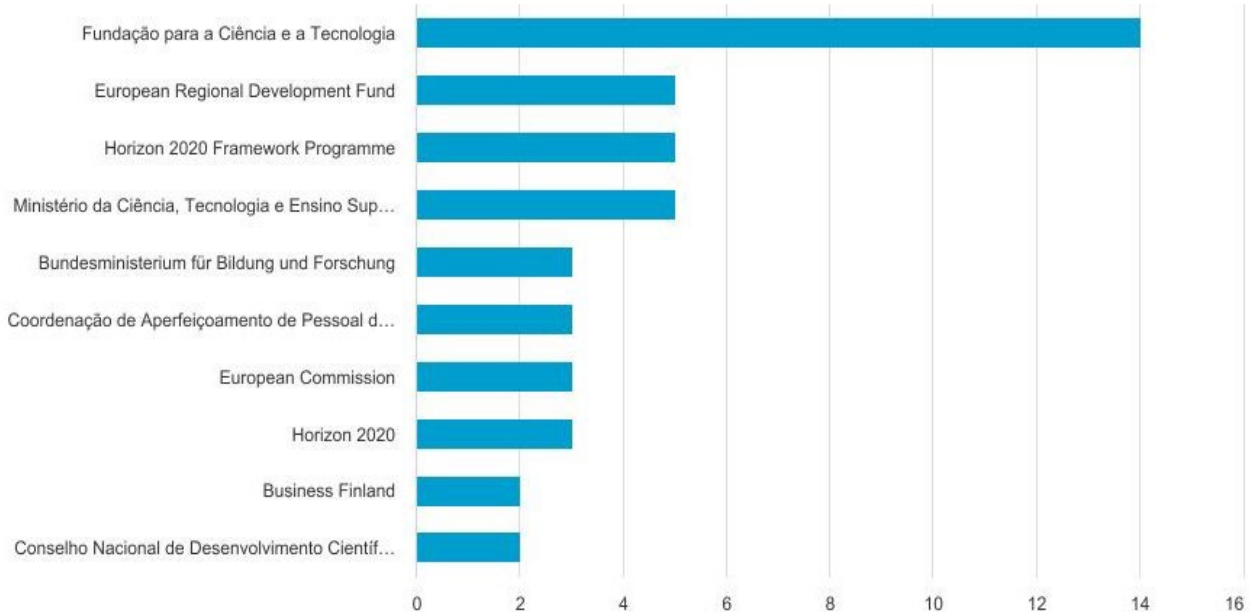

Figure 8 – Number of publications on selected issues by sponsoring organizations that finance scientific research and development

Source: built on the basis of data from the Scopus scientometric database.

In the article, using bibliometric analysis, the main clusters of thematic areas of publications devoted to digital transformation in the context of the concept of Industry 5.0 were identified (Fig. 9).

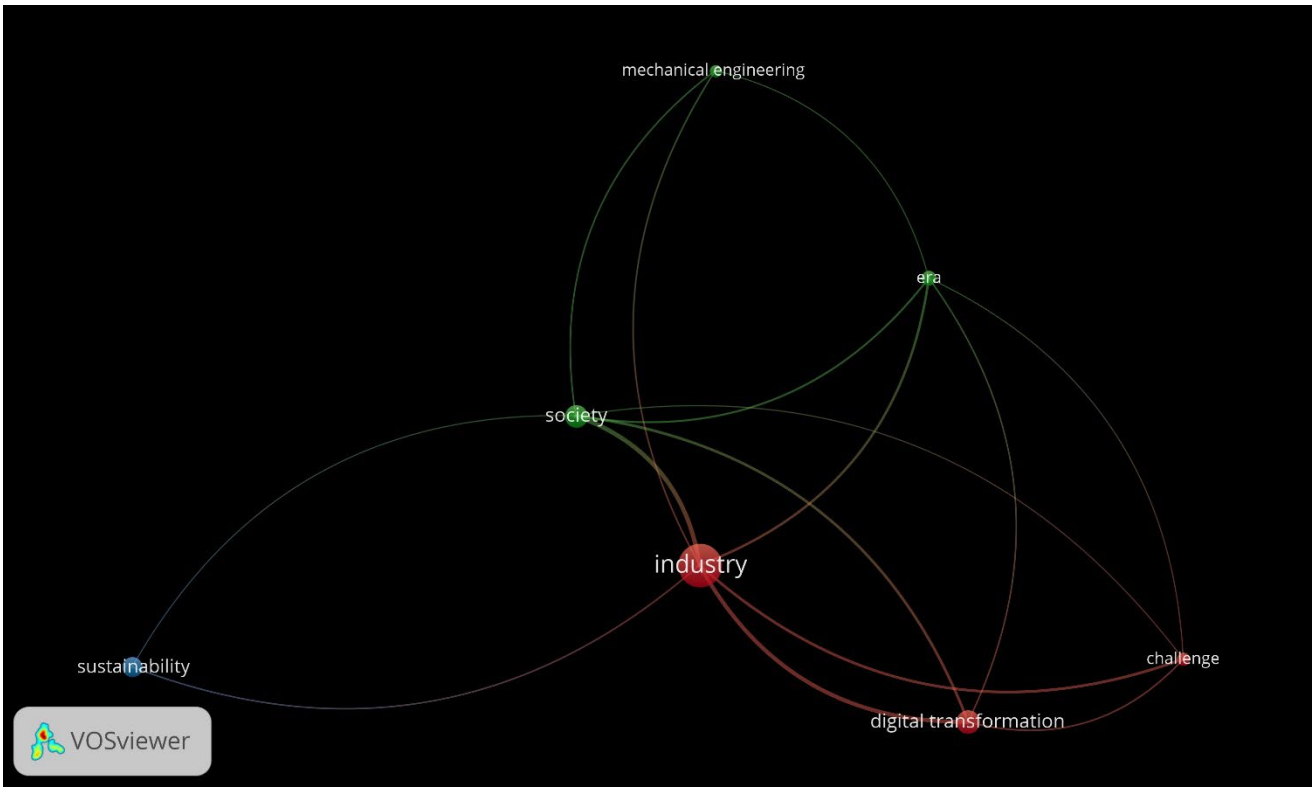

Figure 9 – Network visualization of citations of articles on issues of digital transformation in the context of the implementation of the Industry 5.0 concept using the VOSviewer toolkit
Source: built on the basis of data from the Scopus scientometric database using the VOSviewer program [35].

As can be seen from Fig. 9, each of the clusters symbolizes the direction of scientific research in the field of digital transformation and Industry 4.0 or 5.0. Let's analyze them.

The first cluster (red) contains 3 keywords. Grouped keywords in this cluster indicate that scholars consider digital transformations in the context of the industrial revolution.

The second cluster (green) consists of 2 keywords and focuses on engineering technologies and innovations.

The next cluster (blue) outlines research on digital transformation from the perspective of sustainable development or ecosystem resilience.

If the search is expanded to include, in addition to citation information, bibliographic information, a brief description and keywords, information on funding, etc., 278 keywords can be identified, which are organized into 20 clusters (Fig. 10).

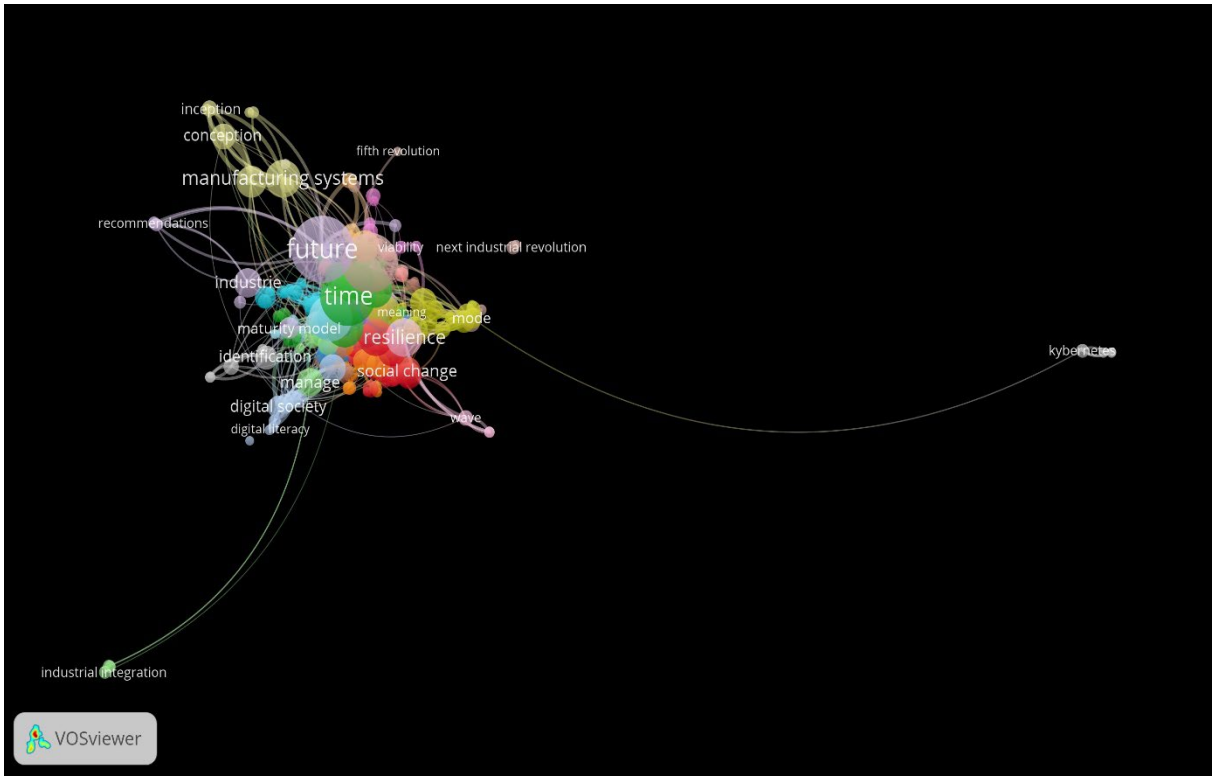

Figure 10 – Network visualization of citations of articles on issues of digital transformation in the context of the implementation of the Industry 5.0 concept using the VOSviewer toolkit

Source: built on the basis of data from the Scopus scientometric database using the VOSviewer program [35].

Therefore, the analysis of publication activity confirmed that since 2016, there has been an increase in scientific interest in the study of transformational changes in the economy under the conditions of Industry 4.0 and 5.0. At the same time, the interdisciplinary nature of research is followed, and the geography of scientists and researchers studying this topic is diverse (but with a noticeable predominance of scientists and institutions from India, Germany, Portugal, Turkey, the USA).

Trend analysis using the Google Trends toolkit confirms the high level of interest worldwide in the subject of "digital transformation" (70 points on average). So, currently, digital business transformation, business transformation, digital transformation strategy, digital strategy are recognized as trending concepts. Among the leaders in terms of popularity, such topics as the digital transformation (100 points); digital business transformation (57); business transformation (53); digital transformation strategy (33); digital strategy (32); digital transformation technology (27); digital transformation management (26); digital transformation data (26); digital technology (25); digital transformation industry (25); digital transformation services (25 points).

It should be noted that the request for the concepts "Industry 4.0" and "Industry 5.0" has a lower level of popularity in the world (on average 24 and 2 points, respectively). The most popular requests are the industry 4.0 (100 points); industry 4.0 manufacturing (54); society 5.0 (31 points).

The term "digital transformation" and "Industry 4.0 technologies" have been the most popular in Ukraine in the last 5 years. The concept of "Industry 5.0" has not yet been implemented in Ukraine.

Conclusions. Based on the above, we can come to the following conclusion. The concept of "Industry 5.0" is designed to expand the digital transformation based on more meaningful and effective collaboration between people and machines and systems

within their digital ecosystem. The partnership of humans and intelligent machines combines the precision and speed of industrial automation with the creativity, innovation and critical thinking skills of humans.

The long-term benefits of implementing Industry 5.0 are consistent with its core values. For example, increasing the attraction and retention of talent, saving energy and increasing overall sustainability. The above advantages help to increase competitiveness and relevance through successful adaptation to a changing world and new markets. These include:

1) Attracting and retaining talented employees. Every year, it becomes more difficult for companies to attract and retain the skilled and talented personnel they need to compete. When workers are mere machine operators, they are denied the task and creative input that drive human achievement. The principles and technologies of Industry 5.0 provide a more progressive and interesting work environment, which can contribute to increased employee satisfaction and loyalty.

2) Sustainable development and competitiveness. In the business world, sustainable practices are not an option, but an expectation of stakeholders. This especially applies to resource- and energy-intensive industries. A forward-looking business with sustainable development in mind will be more attractive to potential investors, employees and consumers. The implementation of Industry 5.0 practices will contribute to the economic performance of industries while simultaneously ensuring environmental sustainability.

3) Stability. The ability to respond to revolutionary changes such as trade wars, pandemics and climate impacts has become a critical component of business management. 5.0 technologies play an important role in the development of flexibility and resilience of industry through data collection, automated risk analysis and increased security.

It should be noted that companies planning digital transformation should start the transformation process with four steps:

– determination of the starting point – performing an audit of existing systems and assets. For a more successful launch of the project, first of all, it is necessary to determine those processes of the company that have a high operational priority and which are the easiest to transform;

– determination of priorities – the advantage of digital transformation is that it does not have to be implemented all at once. Intelligent technologies are built to evolve, scale and integrate;

– preparation of the route card – the most important advantages of intelligent technologies are their high scalability and ability to quickly adapt and change the configuration. An effective transformation roadmap should allow for flexibility and growth, but start the project with a roadmap that includes several important and achievable goals. The plan should include robust change management and migration strategies. Digital transformation involves not only the updating of technologies, but also the development of people. These first steps are very important. You should seek help from experienced specialists who understand the unique needs of the company and are able to help in choosing the optimal course for the business;

– preparation of divisions – intelligent technologies help to reduce the number of repetitive tasks, increase the involvement of employees and ensure effective cooperation. But these benefits can only be realized when these technologies are used by all staff. You should listen to the suggestions and ideas of employees, openly answer their concerns, and give them time to adjust to the changes.

It's equally important to look to your software vendor for help in developing a transformation strategy and roadmap, and to learn which solutions best meet your unique business needs.

The concept of digital transformation in the context of Industry 5.0 should involve the

use of digital tools and platforms to transform traditional business processes, improve interaction with customers, introduce innovative technologies and form a digital ecosystem. The main components of digital transformation of critical infrastructure include:

– digital technologies (cloud computing, artificial intelligence, big data analytics and the Internet of Things (IoT), which allow collecting, analyzing and using huge amounts of data to make informed decisions, automate processes and provide a personalized experience);

– organizational changes (restructuring of processes to increase their flexibility, introduction of new methodologies (DevOps, Agile), formation of a digital culture);

– customer orientation and integration of digital channels (the use of websites, mobile applications and social network platforms will improve the quality of customer service, provide personalized content, and ensure seamless interaction at various contact points).

For effective digital transformation on a practical level, it is advisable to pay attention to such main aspects as: having a clear vision and strategy that meets business goals; involving different groups of stakeholders and ensuring the interest of the entire organization; constant monitoring and evaluation of the implementation of digital transformation initiatives; an adaptive and iterative approach that allows you to navigate the changing digital landscape.

Thus, digital transformation integrates all levels and functional areas of the company. Intelligent technologies provide the most important tools companies need to survive and thrive. Among the main advantages of digital transformation in the conditions of Industry 5.0, the following can be named:

1) In-depth data analysis for real-time decision-making. In many companies, the assessment of work efficiency and return on investment is based on data from past periods. However, the processes of manual data collection, processing and analysis are slow and do not allow to quickly use the opportunities that open up. A modern ERP system and advanced analytics tools allow companies to see data in real time and configure powerful analysis algorithms, ensuring the best decisions are made at exactly the right moment.

2) Increasing efficiency and productivity. Networked devices and IoT devices continuously transmit data, hardware logs, and performance reports. With the help of advanced analytics tools, this data can become the basis for diagnostic maintenance, reduce downtime and provide the information you need, increasing the productivity and efficiency of workflows.

3) Optimizing the customer experience. Clients appreciate the convenience and quality of the process of interaction with the company. Personalization, omnichannel engagement, customized service plans and access to real-time data will help you exceed their ever-changing expectations, increase your leads and retain existing customers by increasing their loyalty.

4) Implementation of innovations in the business model. Consumer and market requirements are changing. The focus of attention is gradually shifting to the modernization of business models as a tool for value creation. However, reshaping fundamental business models and customer experiences is not possible without real-time data collection and analysis, as well as automated intelligent processes to drive new business, payment and service models.

5) Support of a reliable and competitive corporate development strategy. Digitization of operations and optimization of services with the help of network technologies creates new ways of interaction and cooperation, as well as optimizes business development strategy in the areas of: development of new products and services; increase in profitability and strengthening of revenue generation channels; attraction and retention of potential and real customers.

6) Increasing flexibility and resilience to crises. Today's business is eager for digital

transformation because it offers tools for rapid development of products and services, as well as predictive analytics capabilities to prepare for future crises, market changes and new perspectives. Companies need scalability and a full suite of cloud solutions to innovate.

Prospects for further research consist in substantiating the theoretical and methodological provisions of the formation of the digital ecosystem and the digital transformation of the logistics services market under the conditions of Industry 5.0.

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v.24 (2024)
https://smart-scm.org

UDC 338,164.01, 658
DOI: https://doi.org/10.46783/smart-scm/2024-24-11
JEL Classification: Q15, M40.
Received: 18 March 2024

Hryhorak M.Yu., Doctor of Sciences (Economics), Associate Professor, Professor of Enterprise Management Department National Technical University of Ukraine 'Kyiv Polytechnic Institute' named after Igor Sikorsky (Ukraine))

ORCID – 0000-0002-5023-8602
Researcher ID –
Scopus author id: – 57208222758

Chornopyska N.V. PhD (Economics), Associate Professor, Associate Professor at department marketing and logistics at Lviv Polytechnic National University (Ukraine)

ORCID – 0000-0001-9074-7607
Researcher ID –
Scopus author id: –

Marchuk V.Ye. Doctor of Engineering, Professor, Professor of Logistics Department National Aviation University (Ukraine)

ORCID – 0000-0003-0140-5416
Researcher ID – S-6514-2018
Scopus author id: – 57212323045

THE SCIENTIFIC LEGACY OF PROFESSOR Y.V. KRYKAVSKYI: DEVELOPMENT OF LOGISTICS THEORY IN UKRAINE AND FUTURE PERSPECTIVES

Mariia Hryhorak, Chornopyska Natalyia, Marchuk Volodymyr. "The scientific legacy of professor Y.V. Krykavskyi: development of logistics theory in Ukraine and future perspectives". *The article presents the first attempt at scientometric analysis of the scientific legacy of the prominent Ukrainian scholar, Doctor of Economic Sciences, Professor Yevhen Vasylovych Krykavskyi. The main stages of his scientific work and its impact on the development of the general theory and practice of logistic science in Ukraine are identified. It is demonstrated that Y.V. Krykavskyi himself formulated the theoretical foundations of logistics as a separate direction of scientific research in the field of economic sciences, established the basic conceptual framework, founded a scientific school of marketing and logistics, and trained a large number of candidates and doctors of sciences who continue and deepen the theoretical developments of the great scientist, as well as expand the spheres of practical application of logistic concepts, tools, and methods, and supply chain management in new economic conditions.*

Keywords*:* The logistic theory and supply chain management, authored by Yevhen V. Krykavskyi, scientific legacy, scientometric analysis of scholarly works.

Григорак Марія, Чорнописька Наталія, Марчук Володимир. «Наукова спадщина професора Є.В.Крикавського: розвиток теорії логістики в Україні та погляд у майбутнє». *У*

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представленій статті зроблено першу спробу наукометричного аналізу наукової спадщини видатного українського вченого, доктора економічних наук, професора Євгена Васильовича Крикавського. Визначено основні етапи його наукової творчості та її вплив на розвиток загальної теорії і практики логістичної науки в Україні. Доведено що саме Є.В. Крикавський сформував теоретичні засади логістики як окремого напряму наукових досліджень в сфері економічних наук, сформував базовий понятійний апарат, заснував наукову школу маркетингу і логістики, підготував велику кількість кандидатів та докторів наук, які гідно продовжують та поглиблюють теоретичні розробки великого вченого, а також розширяють сфери практичного використання концепцій, інструментів та методів логістики й управління ланцюгами постачання в нових економічних умовах.

Ключові слова: теорія логітики та управління ланцюгами постачання, Крикавський Є.В., наукова спадщина, наукометричний аналіз наукових праць.

On March 5, 2024, the renowned scientist Yevhen Vasylovych Krykavskyi, Doctor of Economic Sciences, Professor, and Head of the Department of Marketing and Logistics at the Lviv Polytechnic National University, passed away. He was a generous soul - a talented educator who paved the way for many Ukrainian scholars, a researcher who significantly shaped and developed the theory of logistics in the Ukrainian academic environment, and a public figure who popularized logistics not only in higher education but also in the business and public sectors. For decades, he served as the responsible editor of the scientific professional publication "Logistics" of the Lviv Polytechnic National University Bulletin, a member of specialized academic councils for the defense of doctoral dissertations D. 35.154.01 of the Institute of Regional Studies of the NAS of Ukraine and D. 35.052.03 of the Lviv Polytechnic National University, and participated in the work of the expert council on economic sciences of the Higher Attestation Commission of Ukraine (2002–2006), the scientific-methodological commission on economics and entrepreneurship, and the scientific-methodological commission on management and administration of the Ministry of Education and Science of Ukraine.

Yevhen Vasylovych Krykavskyi was born on September 12, 1949, in Radkhivshchyna, Lviv region (village of Styrkivtsi). He completed secondary school in 1966 in Radkhiv. In 1970, he entered the Faculty of Engineering and Economics at the Lviv Polytechnic Institute (now the Lviv Polytechnic National University), where he distinguished himself as a talented student, earning the right to receive the Lenin scholarship and graduating with honors in 1975 with a degree in "Economics and Organization of Energy". He began his scientific career in 1975 as an engineer at the research laboratory of the Lviv Polytechnic Institute, and from 1980, he worked at the Department of Economics and Organization of Chemical Industry and Energy (now the Department of Marketing and Logistics) of the same institute. All subsequent scientific and pedagogical activities of Yevhen V. Krykavskyi were associated with this department and its development: he rose from an assistant to a professor and head of the department. From October 1992 to March 2024, he served as the head of the Department of Marketing and Logistics.

Krykavskyi Yevhen Vasylovych

Krykavskyi Yevhen Vasylovych left behind a significant scientific legacy, which constitutes a substantial contribution to the development of logistics science in Ukraine. The purpose of this article is to conduct a scientometric analysis of the scientific work of the renowned scholar. The main sources for writing this article were his monographs, textbooks, teaching aids, collections of scientific papers, as well as publications in periodicals and author's certificates.

Scientific achievements became the defining characteristic of Professor Yevhen Vasylovych Krykavskyi's creative activity, as he made a significant contribution to the development of theoretical provisions in the fields of energy economics, marketing, and logistics. His scientific work includes 23 monographs, 24 textbooks and teaching aids with the approval of the Ministry of Education and Science of Ukraine, and over 400 other publications. Under his supervision, 13 doctoral and 44 candidate dissertations were defended.

Considering the vast quantitative indicators of Professor Yevhen Vasylovych Krykavskyi's scientific legacy, the analysis of his work was conducted according to thematic directions over specific periods.

The main scientific direction of the scholar's research throughout his creative life became the general theory of logistics, to which the majority of his scientific publications were dedicated. As early as 1996, the author published his first book, "Enterprise Logistics," which became the theoretical basis of the dissertation presented for the academic degree of Doctor of Economic Sciences on the topic "Formation of Enterprise Economic Potential Based on Logistics Concepts" and successfully defended in 1997. It is worth noting that at that time logistics in Ukraine was perceived as "terra incognita," so it was a very bold step for

the researcher to include "logistics concepts" in the title of his dissertation, unfamiliar to the majority of the scientific community. Later, Yevhen Vasylovych Krykavskyi published several important scientific articles defending logistics as a separate branch of economic science and proving its significance for the development of organizations as a set of specific management tools and methods for managing material, informational, and financial flows.

Separately, it is necessary to mention the scientific works dedicated to the formation of the terminological basis of logistics as a science, the theoretical and methodological principles of organizing and conducting logistic activities in enterprises of various economic sectors. In particular, the textbook "Logistics: Basics of Theory" discusses the concept, goals, and objectives of logistics, methodological apparatus, and logistics tools, identifies objects of logistic management, explores logistic functions and logistic management in the enterprise management system, and substantiates the logistic approach to managing material flows in production and distribution of goods.

The analysis of Yevhen Vasylovych Krykavskyi's scientific legacy indicates that the management of enterprise logistics activity was a constant focus of his research. He firmly believed that logistics is not only a management concept but also a philosophy of enterprise management that requires specific thinking. This thinking is oriented towards the value and utility of space, time, information, and more; thinking in systemic categories based on the interdependence of resources and processes; thinking in terms of total or full costs, which involves resolving conflicts between costs and goals; thinking in terms of service (order cycle, reliability, quality, and flexibility of order fulfillment); and thinking in terms of efficiency.

Defining the essence of modern enterprise management in the book "Logistics Management," the scholar emphasizes the integration of logistics management, structured into strategic and operational areas. The tasks and principles of strategic logistics management are related to integrating logistics into the structure of enterprise strategic planning, formulating logistics strategy as part of corporate strategy, and specifying strategic objectives through the implementation of logistics projects, among others. The main goal of operational logistics management is to ensure harmonious cooperation through the synchronization of logistics processes and coordination of logistics functions within other structural units. In this context, Yevhen Vasylovych thoroughly researched the forms of organizing logistics activities within the enterprise and paid attention to coordinating and avoiding conflicts in goal structure, exchanging information between functional areas within the enterprise, especially the interaction of logistics, marketing, finance, and others.

The economic aspects of logistics activity and mechanisms for creating sustainable competitive advantages were disclosed in the book "Logistics for Economists." Particularly, the author's position was based on the idea that only orientation towards total costs, total value, and the entire cycle would allow achieving a synergistic result in the form of additional cost savings, value (benefit) for the customer, and the level of customer service. He argued that due to changes in consumer demands regarding product and service customization and the need to provide a wide range of products, mass production shifts from the assembly stage to the component manufacturing stage, thus realizing economies of scale in the final product. Analyzing the understanding of enterprise logistics as a system of material, money, and information flow management, the scholar concluded that the subject of logistics research could be anything that is the subject of logistics considerations, namely, the logistic product and service, representing a set of accepted customer requirements in a specific logistics system. Thus, economic cooperation enables various economic entities to integrate their activities for joint

creation of consumer value, harmonize economic interests focusing on the end consumer, and achieve a multiplier effect.

It is worth noting that Yevhen Vasylovych was very responsive to market changes and the diffusion of knowledge and experience in logistics. He warned against primitive views on logistical problems and solutions, the opportunistic use of the term "logistics," and sought to foster logistic thinking not only among students but also within the scientific community. Generalizing global trends in logistics and supply chain management, analyzing trends in international and national logistics service markets, closely collaborating with foreign colleagues, and participating in numerous scientific and practical conferences were part of his approach. For instance, in 2014, a new book titled "Logistics Economics" was published, prepared by a team of authors under the leadership of Yevhen Vasylovych. This book examined the place and role of logistics as an economic sector, identified the composition of logistics assets, further investigated the economic potential of logistics and its synergistic effect, and proposed methodological approaches to evaluating the results of logistics activities. A crucial conclusion was made about the need for infrastructure development, particularly logistics infrastructure, in the transition of Ukraine to market methods of management. This required state support through legislative regulation, infrastructure planning, and creating favorable conditions for investment in transportation, warehousing, and other infrastructure objects.

The most comprehensive exposition of the theory and practice of modern logistics is the book "Logistics and Supply Chain Management" [11]. The authoring team, led by Yevhen Vasylovych Krykavskyi, synthesized the methodological foundations of supply chain management and investigated the strategic and operational role of logistics as one of the key business processes. Specifically, the basic principles of supply chain management are outlined, and its internal business processes are described in detail using two well-known reference models commonly employed in supply chain management practice - the SCOR and GSCF models. Typical solutions for supply chain planning are also provided.

A separate focus is given to the characterization of information technologies, the use of which in supply chains enables the formation of a database serving as a source of information for evaluating and continuously monitoring the performance of the supply chain at all levels. It should be noted that in this book, Yevhen Vasylovych viewed the supply chain as a variant of full systemic integration of processes involving supply, production, and distribution, which alters the established boundaries of operation of individual participants, forming a new logistic system of higher hierarchy.

Interorganizational cooperation in supply chains enables inventory management through joint optimization of inventories of all cooperating enterprises based on long-term partnerships, requiring specific logistics management tools, differentiated requirements for information exchange, alternative decisions, and evaluation of the level of achievement of set goals. Therefore, theoretical principles of logistics and supply chain management are illustrated with a large number of widely recognized management techniques and tools, taking into account the practical experience of leading foreign and domestic enterprises.

In 2019, Professor Y.V. Krykavskyi, in collaboration with N.V. Chornopysska, published the book "Logistic Systems," dedicated to the fundamental principles of designing logistic systems, the peculiarities of organizing logistic systems at different integration levels (intra-production systems, supply chains, logistic networks, and global logistic systems), as well as methodological approaches to evaluating the parameters of functioning and development of logistic systems [12]. This book became the next stage in the evolution of the theory of logistic systems, the foundation of which was laid back in 1999 [13], and then developed in the

textbook "Logistic Systems" [14]. Yevhen Vasylovych considered the concept of a logistic system crucial in understanding the general concept of logistics. He developed classification features and identified various classes of logistic systems at micro-, meso-, and macro-levels, determining the main determinants of the functioning and development of logistic systems. The theoretical issues of logistic systems' functioning were investigated by graduate students and doctoral students of the eminent scientist and found their reflection in collective monographs under his scientific editorship, including "Economics of Logistic Systems" [15-17].

Of course, while heading the marketing and logistics department for many years, Y.V. Krykavskyi constantly researched the interrelationship and mutual influence of two sciences - marketing and logistics. The best embodiment of this connection was the international scientific-practical conference with the expressive title "Marketing and Logistics in Management System," which was regularly held starting from 1996. Typically, this was a meeting place not only for leading scientists of Ukraine but also for many researchers from Poland, Germany, Slovakia, and other countries. During plenary and sectional sessions, the latest theoretical and applied research results of scientists on current trends and prospects for the development of marketing and logistics in modern conditions were presented, and the experience of applying innovative technologies in the activities of domestic and foreign enterprises was generalized. Naturally, the results of scientific discussions found their reflection in the publications of Y.V. Krykavskyi and his colleagues. Already during the first conference, Yevhen Vasylovych formulated the main idea of the conference - marketing and logistics are a perspective view [18], and then developed this idea in his subsequent publications [19-22].

In the photo: Presentation of the State Award "Merited Worker of Education and Science of Ukraine."

Among the main scientific results of a later period, the following should be noted:

– The conceptualization of resolving the conflict between marketing (business) goals and environmental goals, which involves a comprehensive combination of processes: reducing consumer motivations for purchasing packaged products; increasing producers' motivations to use reusable and biodegradable packaging and environmentally safe disposal operations; creating accessible proper infrastructure for reusable packaging and packaging material [23].

– The justification for combining the rational with the irrational in business behavior of participants in integrated organizations, using the example of supply chains, which positively influences the formation of their value orientations, including societal ones, ensures the formation of partnership relations between participants, and contributes to competitiveness growth [24].

– The rationale for ensuring complementarity between marketing and logistics strategies in supply chains through the implementation of the ECR (Efficient Consumer Response) strategic model, which provides the desired flexibility of the supply chain by providing appropriate elasticity to those processes that do not require radical changes and investments. It has been demonstrated that "agile logistics" serves as a compromise solution to the "efficiency versus flexibility" dilemma of the supply chain, whose effectiveness is ensured by: flexibility in physical delivery, purchasing, distribution, and demand management [25].

– The investigation of marketing and logistics peculiarities of enterprises in the agricultural sector and the development of practical recommendations for improving the activities of agricultural enterprises based on marketing and logistics principles [26].

In the photo: from right to left, S. Kubiv presents the Honorary Diploma of the Cabinet of Ministers of Ukraine to Ye. Krykavsky.

It is noteworthy that at different stages of his career, Yevhen Vasylovych favored either marketing or logistics, sometimes combining them under the principles of marketing logistics. For him, they were two wings of the same whole. However, he stated that marketing represents our desires, while logistics represents our capabilities. And marketing logistics is a concept of developing logistic systems aimed at optimally satisfying customer needs to achieve sustainable competitive advantages through the integration, optimization, and rationalization of logistic flows. Digital technologies provide flexibility in physical delivery, purchasing, distribution, and demand management in this context.

Summarizing the scientific legacy of Ye. Krykavsky, it can be concluded that his scientific interests were extremely diverse. Among the main research directions that interested the scientist during the last period and continue to be developed by his students, the following should be noted:

1. The concept of the "logistic passport of the country" was introduced, characterizing the state and dynamics of development of the national logistics sector, its role in the country's economy, and ways to develop logistics infrastructure. Special attention was paid to the development of inland water transport, river transportation, and attracting investments in the development of port infrastructure.

2. Informational groundwork was formed to justify market approaches to managing poorly urbanized territories, combining strategic management and territorial marketing. It was determined that the attractiveness of a territory creates the basis for competition among economic agents and determines the conditions for population living, servicing and recreation, conducting business, and staying for tourists (both existing and potential).

3. The theoretical and methodological principles of developing business strategies for enterprises in complex technical systems were formulated. It was proven that small and medium-sized enterprises do not have sufficient potential for development, so they should be involved in global supply chains. Strategic partnership involves aligning the goals and objectives of the supply chain with the goals and strategies of enterprises, allowing for better adaptation to global challenges and threats.

4. The impact of military actions on changing the logistic landscape of the country was studied, and the strategic consequences for the future development of the logistics sector, rapid development of humanitarian logistics, and supply chain management in conditions of constant danger, fragility, anxiety, non-linearity, and uncertainty were assessed.

Therefore, a bibliometric analysis of the scientific heritage of Professor Ye. Krykavsky convincingly testifies to his significant contribution to the development of the theory and practice of logistics in Ukraine, as well as to the training of personnel for the logistics sphere. For outstanding achievements in the teaching position, he was awarded the "Excellence in Education of Ukraine" badge (2006), and in 2007, by the Decree of the President of Ukraine, he was awarded the honorary title "Merited Worker of Education." The scientist's favorite expression was: "If you stop wanting, you will be dead." Ye. Krykavsky wanted to be active, useful, creative, and innovative until his last days. He explored the world around him and changed himself, flexibly responding to changes and leaving traces of these changes in his numerous publications. The bright image of Professor Ye. Krykavsky will remain in our hearts forever, and his works will encourage new searches and motivate new researchers.

Conclusions. Therefore, the scientific metrics analysis of the academic legacy of Dr. Evgen Vasiliovich, a professor of economics, attests to his significant contribution to the development of the general theory of logistics in Ukraine as a specific direction of research in the field of economic sciences. Published monographs, textbooks, educational manuals, compilations of

scientific works, and numerous scientific articles formed the fundamental conceptual apparatus of this science, its methodological basis, and practical toolkit. The scholar deeply believed that logistics is not only a management concept but also a philosophy of enterprise management that requires specific thinking oriented towards the value and utility of time, space, and quality of customer service. Systems thinking and a systemic approach allowed for the formation of a set of theoretical propositions and methodical approaches to the design, optimization, and development of logistic systems at micro, meso, and macro levels. Heading the marketing and management department of Lviv Polytechnic for over 30 years, he laid the foundation for research related to marketing logistics.

Summarizing the scientific work of Evgen Vasiliovich Krykavsky, it can be concluded that his scientific interests were extremely diverse, reflecting the international scientific-practical conference "Marketing and Logistics in Management System" initiated by him. Evgen Vasiliovich researched problems of regional development and the formation of regional logistic systems, logistic strategies, and business models of enterprise management, organization of marketing and logistic activities of enterprises, concepts of sustainability and digitization of logistic processes, supply chain management, deepening the sectoral direction of logistics, tracking the dynamics of the logistic services market, and the logistic landscape of the country, etc.

The favorite expression of the scholar was: "If you stop wanting, you will be dead." Evgen Vasiliovich wanted to be active, useful, creative, and innovative until his last days. He explored the world around him and changed himself, flexibly responding to changes, and left the consequences of these changes in his numerous publications. The bright image of Professor Evgen Vasiliovich will remain in our hearts forever, and his works will inspire new searches and motivate new researchers.

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The electronic scientifically and practical journal
"INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT",
ISSN 2708-3195

119-125
v.24 (2024)
https://smart-scm.org

UDC 338
DOI: https://doi.org/10.46783/smart-scm/2024-24-12
JEL Classification: M20, M41.
Received: 29 March 2024

Kostiuk Olga, Ph.D., associate professor, associate professor of Department of Administrative Management and Foreign Economic Activities, Faculty of Agrarian Management, National University of Life and Environmental Sciences of Ukraine (Ukraine)

ORCID – 0000-0002-6425-2739
Researcher ID –
Scopus author id: – 57223010892

Chikalkin Serhii. Postgraduate student of the Department of Finance and Accounting Open International University of Human Development "Ukraine" (Ukraine)

ORCID – 0009-0006-7629-3382
Researcher ID –
Scopus author id: –

THE ROLE OF MANAGEMENT CONSULTING IN THE CORPORATE GOVERNANCE SYSTEM

Olga Kostiuk, Serhii Chikalkin. "The role of management consulting in the corporate governance system". *The article is devoted to the study of topical issues related to management consulting in corporate governance. Management consulting plays an important role in the corporate governance system, helping companies to achieve their strategic goals and optimize their operations through innovative approaches and solutions.*

It has been determined that management consultants are becoming key figures in helping companies develop strategies, optimize processes and solve complex management problems. In the context of globalization and rapid technological transformation of business, management consulting is becoming an integral component for companies seeking to remain competitive and adapt to new market realities.

The author characterizes that the development of management consulting is not only diverse, but also takes two main forms. On the one hand, (and this has developed historically), consulting is a method of improving the existing forms of management and business, because initially the consulting process was a process of imitating the experience of the most successful managers. On the other hand, consulting is becoming an independent profession.

The article analyzes risk management in a corporate enterprise, which includes identification, assessment and mitigation of risks that may affect the organization's goals, operations or stakeholders.

It is highlighted that corporate governance is the systems, processes and principles by which a business is managed, regulated and controlled. The importance of effective governance increases linearly with the size of the business and the number of shareholders.

It is noted that foreign investors often look for companies with effective management, transparent and accountable business. For small and medium-sized enterprises seeking to expand their operations and enter foreign markets, having a sound corporate governance practice can be a significant advantage. For foreign investors, it demonstrates the reliability of the business, reduces the potential risks associated with investments, and can create more favorable conditions for investment.

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It is proved that the creation of reliable mechanisms is necessary to control the financial integrity and operational efficiency of the enterprise.

***Keywords**:* management, management consulting, corporate governance, enterprise, management, corporation, shareholders, innovation, business.

Ольга Костюк, Сергій Чікалкін. «Роль управлінського консультування в системі корпоративного управління». *Стаття присвячена дослідженню актуальних питань щодо управлінського консультування в корпоративному управлінні. Управлінське консультування відіграє важливу роль в системі корпоративного управління, допомагаючи компаніям досягати своїх стратегічних цілей та оптимізувати свою діяльність за допомогою інноваційних підходів та рішень.*

Визначено, що управлінські консультанти стають ключовими фігурами у допомозі компаніям у розробці стратегій, оптимізації процесів та вирішенні складних управлінських завдань. В умовах глобалізації та швидкої технологічної трансформації бізнесу, управлінське консультування стає невід'ємною складовою для компаній, що прагнуть залишатися конкурентоспроможними та адаптуватися до нових реалій ринку.

Охарактеризовано, що розвиток управлінського консультування набуває не тільки різноманітного забарвлення, але й постає у двох основних формах. З одного боку, (і це склалось історично) консультування виступає методом удосконалення діючих форм управління та ведення бізнесу, адже спочатку процес консультування уявляв собою процес наслідування досвіду найбільш успішних менеджерів. З іншого – консультування набуває ознак самостійної професії.

Проаналізовано управління ризиками на корпоративному підприємстві, яке включає в себе ідентифікацію, оцінку та зменшення ризиків, що можуть вплинути на цілі організації, її операції або на стейкхолдерів.

Висвітлено, що корпоративне управління – це системи, процеси та принципи, за допомогою яких управляється, регулюється та контролюється бізнес. Важливість ефективного управління зростає лінійно із збільшенням розміру бізнесу та кількості акціонерів.

Зазначено, що іноземні інвестори часто шукають підприємства з ефективним управлінням, прозорим та підзвітним бізнесом. Для малих та середніх підприємств, які прагнуть розширити діяльність і вийти на іноземні ринки, наявність надійної практики корпоративного управління може бути значною перевагою. Для іноземних інвесторів це свідчить про надійність бізнесу, знижує потенційні ризики, пов'язані з інвестиціями, і може створити більш сприятливі умови для інвестування.

Доведено, що створення надійних механізмів необхідні для контролю забезпечення фінансової доброчесності та операційної ефективності підприємства.

Ключові слова: управління, управлінське консультування, корпоративне управління, підприємство, управління, корпорація, акціонери, інновації, бізнес.

Introduction. Management consulting is one of the most dynamic and rapidly developing areas. The business environment in which companies operate is constantly changing under the influence of technological progress, globalization, political and economic changes. In this environment, companies are looking for effective strategies and tools to operate successfully, and they turn to management consultants for help. Companies are looking for experts who can provide them with best practices, new ideas and strategies to solve complex management problems. Management consultants are able to provide expert solutions to specific business problems because of their experience and analytical skills. A successful corporation is a public

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company with thousands of shareholders, possibly with several classes of shares and many different creditors in the end state. Good corporate governance ensures the efficient and effective use of resources, which improves financial performance and contributes to the company's financial growth. Various tools are used for this purpose. One of these tools is management consulting.

Analysis of recent research and publications. The scientific basis for the role of management consulting in the corporate governance system is formed by the works of domestic and foreign scholars, among them: M. Bezkrovnyi, A. Carroll, A. Gross, M. Kropyvko, K. Linda, O. Linkova, Yu. Palekha, V. Sokolenko, Linkova, O. and others. But many questions on this issue require further scientific research.

The formulation of the goals of the article is to investigate the impact of management consulting on the effectiveness of corporate governance and to identify its key role in shaping strategies and making management decisions in modern business conditions.

Presentation of the main results. Management consulting is a dynamically developing field in today's environment. Management consultants have the ability to quickly adapt to new situations and client needs. They work with a variety of companies and industries, which requires them to be flexible and able to respond quickly to new challenges. Modern technologies, such as data analytics, artificial intelligence, and automation, allow management consultants to provide more accurate and effective advice to their clients [1].

Today, the development of management consulting is not only diverse, but also takes two main forms. On the one hand, (and this has been the case historically), consulting is a method of improving existing forms of management and business, because initially the consulting process was a process of imitating the experience of the most successful managers. On the other hand, consulting is becoming an independent profession. The most famous contemporary expert in the field of management consulting, M. Kubr, defines this profession as follows: "Management consulting is an activity aimed at providing independent professional services that are advisory in nature and help managers and organizations to achieve organizational goals and objectives by solving management and business problems, identifying and using new opportunities, implementing changes and training". This approach to defining the essence of management consulting organically combines two approaches that have developed in the science of this type of activity. The first one is functional, broader in nature, emphasizing that management consulting can be viewed as a method of action that provides practical advice and assistance that can be provided by any person. The second one considers management consulting as an independent professional service [2].

Management consulting plays an important role in the corporate governance system, its helping companies achieve their strategic goals and optimize their operations. Here are a few aspects of the role of management consulting in the corporate governance system in tab. 1.

Management consulting serves as an important element of the corporate governance system, helping companies achieve their goals and ensure their resilience and competitiveness in the market.

Corporate governance is the systems, processes and principles by which a business is managed, regulated and controlled. The importance of effective governance increases linearly with the size of a business and the number of shareholders [5].

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Table 1 – Some components of management consulting in the corporate governance system

№	Components	Brief description
1.	Expertise and Experience	Management consultants bring their expertise and experience in various areas, including strategic management, finance, marketing, operations management, and others. They can help the company develop effective management strategies and practices to achieve its goals.
2.	Objective Assessment and Advice	Management consultants can provide an objective assessment of the company's current state, its processes, and strategies. This allows the company to gain new insights and advice on how to improve its operations and achieve greater efficiency.
3.	Support for Strategic Management	Management consultants can help the company identify its strategic goals and develop action plans to achieve them. They can also provide recommendations on how to implement strategic changes and adapt to changes in the business environment.
4.	Enhancing Efficiency and Productivity	Through management consulting, companies can identify and address issues that hinder their efficiency and productivity. Consultants help improve business processes, optimize resources, and enhance management practices.
5.	Training and Development	Management consultants can provide training and development for the company's staff, helping to enhance their knowledge and skills in management and business development.

Source: on [2].

Good corporate governance ensures that a business is run honestly and ethically. It builds trust between customers, employees, and investors, especially through good management advice.

Successful corporations have a Management board that collectively makes strategic decisions. This team may include a management consulting specialist who will be engaged in their activities. This reduces the likelihood of making the wrong decision, which will lead to financial losses. The Management Board consists of key people in the company, each of whom is responsible for their own area of work [3].

Efficient use of resources.

Good corporate governance ensures the efficient and effective use of resources, which improves financial performance and promotes growth. Various tools are used for this purpose. Identified and described value propositions for each type of customer (IT, agriculture, energy) allow us to segment advertising and communicate with customers in their language.

Internal customers diversify the influence of one person on all processes. For example, the customer for the lead generation task is the head of the customer service department. This way, the task is freed from unnecessary comments from employees who do not directly affect customer service.

Every extra person can lead the process down the wrong path, which can cost the company time and money. In other words, effective policies, structures, and processes help to reduce over-reliance on a few "key people or employees" [10].

Risk management.

Risk management in a corporate enterprise involves identifying, assessing, and mitigating risks that could impact the organization's objectives, operations, or stakeholders. The key aspects of risk management at a corporate enterprise:

1. The first step in risk management is identifying potential risks that the organization may face. This involves analyzing internal and external factors that could negatively affect the achievement of corporate goals. Risks can vary widely and may include financial risks, operational risks, regulatory risks, market risks, cybersecurity risks, and more.

2. Once risks are identified, they need to be assessed to determine their likelihood and potential impact. This involves evaluating the probability of each risk occurring and estimating the magnitude of its potential consequences. Risk assessment techniques such as risk matrices, risk heat maps, and scenario analysis can be used to prioritize risks based on their severity and develop strategies for managing them.

3. After assessing risks, the organization develops and implements risk mitigation strategies to reduce the likelihood or impact of identified risks. This may involve implementing internal controls, developing contingency plans, purchasing insurance, diversifying operations, or hedging financial exposures. The goal is to minimize the organization's exposure to risk while maximizing its ability to achieve its objectives.

4. Risk management is an ongoing process that requires regular monitoring and review. The effectiveness of risk mitigation strategies should be continuously assessed, and adjustments should be made as necessary based on changes in the business environment or the emergence of new risks. This ensures that the organization remains proactive in managing risks and adapting to evolving threats .

5. Effective risk management is closely integrated with the organization's corporate strategy. Risk management decisions should align with the organization's overall objectives, values, and risk appetite. By embedding risk management into strategic planning processes, corporate enterprises can better anticipate and address risks as they pursue their business goals [8].

Overall, risk management is essential for corporate enterprises to navigate uncertainty, protect value, and sustain long-term success in a dynamic and competitive business environment. It requires a systematic approach, proactive mindset, and ongoing commitment from all levels of the organization.

Attracting foreign investment.

Foreign investors often look for companies with good governance, transparent and accountable business practices. For small and medium-sized enterprises seeking to expand their operations and enter foreign markets, having sound corporate governance practices can be a significant advantage. For foreign investors, it demonstrates the reliability of the business, reduces the potential risks associated with investments, and can create more favorable conditions for investment [3].

How the war has changed the corporate governance of state-owned companies.

Investments from private or institutional funds are given to companies that meet two strategic requirements.

1. Low risk of bankruptcy.

2. High probability of receiving dividends.

Key stages of implementing effective corporate governance.

Assess the current corporate governance structure and practices. Identify areas for improvement. It is also necessary to create a charter or code of corporate governance that outlines the roles, responsibilities and expectations of stakeholders.

You need to make a detailed description of the company's functions. "A good person is not a profession". Each employee should correspond to the described function, which is part of the overall production process.

The next step is to form a board of directors (board) as a collective body that makes strategic decisions. The directors (board members) are assigned to their respective functions: operational management, marketing, HR, and finance. The board includes internal and external

members to ensure that decisions are balanced [11].

One person cannot have all the competencies. The financial director is not engaged in marketing, and the marketer is not engaged in recruiting. These are obvious things that even experienced owners and top managers often ignore. Each board member must understand why they are here and what is expected of them.

Robust mechanisms are needed to monitor financial integrity and operational efficiency. Some companies use the SIPOC system. It helps to see the big picture, shows where the process begins, what steps should be taken, and where the process ends.

It is necessary to communicate regularly with all stakeholders: shareholders, employees, customers. Take their feedback seriously and take it into account in management. In particular, a diversity of opinions is needed in group decision-making [4].

A specific feature of management consulting is the organic combination of management theory and practice. A consultant is an expert in organizing an effective human resources management system and improving organizational change management. A modern consultant is able to solve a wide range of problems of varying complexity that arise at different organizational levels [9].

The main objective of management consulting is to assist clients in solving their management and business problems, and to improve the efficiency of the organization as a whole. Characteristic features of consulting activities are:

1) continuous accumulation of new knowledge and experience on the part of both the client company and the consultant, since the consulting process involves fruitful cooperation between the two stakeholders, as a result of which the client gains new knowledge about effective management, and the consultant gains experience that lays the foundation for further development of his or her competencies;

2) the recommendatory nature of the consultant's assistance; the specialist's responsibility is related to the completeness and quality of the advice and recommendations offered to the manager; the decision to implement the proposed actions is made exclusively by the company's manager;

3) independence of the consultant; the management specialist is primarily an expert who provides objective information and expresses unbiased conclusions and advice regarding the real state and development prospects of the client company;

4) an integrated approach to the consultant's work; since the lion's share of the problems that the consultant helps to solve relates to the work of the organization as a whole or its individual units, the changes that occur as a result of the introduction of innovations necessarily entail economic, organizational, technical, social and psychological transformations of varying degrees of complexity and quality; this makes the consultant's activity very responsible and requires high professionalism [6].

It should be noted that consulting as an "industry of advice and assistance" has a wide range of applications. However, the subject field of management consulting is the resolution of issues related primarily to the crisis of resources, loss of control, strategy, goals, disruption of structure, disintegration of values, crisis of ideals, conflict of roles, imbalance of rights and responsibilities or dysfunctional conflict between departments. Since people are an integral part of these processes and cannot be considered outside of them (even when it comes to personal and autonomous problems of an individual employee of an organization), the work of a management consultant should be focused on the development of social technologies for effective company management [7].

Conclusions. Thus, fruitful cooperation between the consultant and the client during the implementation of a consulting project leads to new company efficiency, which is achieved through the development of new

skills and abilities of the client organization's personnel, the emergence of new or modernization of existing systems (for example, a production management system or a personnel selection and evaluation system), the establishment of beneficial relationships and the formation of new behavior (corporate culture).

Management consulting remains a dynamic field due to the constant changes in the business environment and the need for expert advice and innovative solutions.

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Scientific publication

INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

The electronic scientifically and practical journal

Electronic scientifically and practical journal “Intellectualization of logistics and Supply Chain Management” included in the list of scientific publications of Ukraine in the field of economic sciences (category "B"): **Order of the Ministry of Education and Culture of Ukraine dated October 10, 2022 No. 894 (Appendix 2)**

Field of science: Economic.

Specialties: 051 – Economics; 073 – Management

ISSN 2708-3195

DOI: https://doi.org/10.46783/smart-scm/2024-24

The electronic magazine is included in the international scientometric databases:
Index Copernicus, Google Scholar

№ 24 (2024)
April 2024

ISSN 2708-3195
DOI: https://doi.org/10.46783/smart-scm/2024-24