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Artificial Intelligence as a Tool Supporting Organizational Entrepreneurship – Theoretical Problems and Case Analysis

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Abstract

Purpose: This article aims to present the results of qualitative research on the analysis of the relationship between artificial intelligence (AI) and organizational entrepreneurship. The purpose of this research is to determine, in terms of qualitative analysis, what kind of relationships are taking place. AI is part of a new trend in the development of digital technology, defined by the acronym DARQ. Its elements are the following digital systems: Distributed Ledger, Artificial Intelligence, Extended Reality, Quantum Computing.
Methodology: The research procedure consists of the following stages: a literature analysis, qualitative research in the focus group, evaluation by experts, and the presentation of results, conducting three case analyses from various industries during the activity, which present the extent to which AI affects organizational entrepreneurship.
Results: The research showed user support for the use of AI technology, especially in the implementation of procedures that support organizational entrepreneurship. The AI applied in the organization enables us to obtain effects on such elements of organizational entrepreneurship as creating new strategic solutions, evaluating these proposals, and monitoring the approach of the organization's management through the use of tools such as a management cockpit and simulation models. The use of artificial intelligence in

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a modern organization is necessary to improve multifaceted and interdisciplinary processes that support organizational entrepreneurship. The use of AI shows the usefulness of digital technology in operational and strategic management.

Limitations: Due to the lack of empirical, especially quantitative, materials concerning the application of all levels of categorization of the use of artificial intelligence in the discussed cases, supplementary research is required to provide a more comprehensive analysis of its applications.

Originality/value: The thesis was justified that IT systems containing AI technology solutions are helpful in the implementation of procedures supporting organizational entrepreneurship. The thesis is complemented by a study consisting of examining the truthfulness of the statement that the consequence of using AI is to obtain in an organization the effects of both generating proposals for new development solutions and verifying the feasibility of the implementation of the procedures proposed by the organization management. The conducted research focuses on the assessment of the relationship between advanced information technologies and organizational entrepreneurship.

Keywords: AI, artificial intelligence, organizational entrepreneurship, qualitative research, DARQ digital technology.

JEL: M15, O32, O33, L26

Sztuczna inteligencja jako narzędzie wspomagające przedsiębiorczość organizacyjną – problemy teoretyczne i analiza przypadków

Streszczenie

Cel: celem artykułu jest przedstawienie wyników badań jakościowych dotyczących analizy relacji zachodzących między AI a przedsiębiorczością organizacyjną. Badania te mają na celu określenie, za pomocą analizy jakościowej, jakiego rodzaju relacje zachodzą. AI jest elementem nowego trendu w rozwoju technologii cyfrowej, który określony jest akronimem DARQ. Jego elementami są następujące systemy cyfrowe: Distributed Ledger, Artificial Intelligence, Extended Reality, Quantum Computing.

Metodologia: procedura badawcza składa się z następujących etapów: analizy literatury, przeprowadzenia badań jakościowych w grupie fokusowej, ewaluacji przez ekspertów i prezentacji wyników, przeprowadzenia trzech analiz przypadków z różnych branż w trakcie działalności, w których przedstawiono w jakim zakresie AI wpływa na przedsiębiorczością organizacyjną.

Wyniki: badania wykazały poparcie użytkowników dla zastosowania technologii AI, zwłaszcza przy realizacji procedur wspomagających przedsiębiorczość organizacyjną. Zastosowane AI w organizacji umożliwia uzyskanie efektów dotyczących takich elementów przedsiębiorczości organizacyjnej, jak: kreowanie nowych rozwiązań strategicznych, oceny tych propozycji oraz monitorowania propozycji kierownictwa organizacji poprzez stosowanie takich narzędzi, jak kokpit menedżerski czy modele symulacyjne. Użytkowanie we współczesnej organizacji AI jest niezbędne dla doskonalenia wieloaspektowego i interdyscyplinarnego procesów wspomagających przedsiębiorczość organizacyjną. Zastosowanie AI pokazuje użyteczność technologii cyfrowej w operacyjnym i strategicznym zarządzaniu.

Ograniczenia/implikacje badawcze: ze względu na brak materiałów empirycznych, szczególnie ilościowych, dotyczących zastosowań wszystkich poziomów kategoryzacji wykorzystania sztucznej inteligencji w omawianych przypadkach wymagane jest przeprowadzenie badań uzupełniających oraz pełniejszej analizy jej zastosowań.

Oryginalność/wartość: uzasadniono tezę, iż systemy informatyczne zawierające rozwiązania technologii AI są pomocne w realizacji procedur wspomagających przedsiębiorczość organizacyjną. Uzupełnieniem postawionej tezy jest realizacja zadania badawczego polegającego na zbadaniu prawdziwości stwierdzenia,

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że konsekwencją zastosowań AI jest uzyskanie w organizacji zarówno efektów dotyczących generowania propozycji nowych rozwiązań rozwoju, jak i weryfikacja realności realizacji procedur proponowanych przez kierownictwo organizacji. Przeprowadzone badania koncentrują się na ocenie relacji zaawanasowanych technologii informatycznych z przedsiębiorczością organizacyjną.

Słowa kluczowe: AI, sztuczna inteligencja, przedsiębiorczość organizacyjna, badania jakościowe, technologia cyfrowa DARQ.

1. Introduction

The data-driven economy is a challenge for the development in the 21st century, both in the social and economic dimensions. The article presents an analysis of changes under the influence of artificial intelligence (AI) in the system that supports organizational entrepreneurship. They are mainly the result of improving the management infrastructure, including the progress made in digital technology. Artificial intelligence is part of a new trend in the development of digital technology, which is defined by the acronym DARQ (Kisielnicki & Zadrożny, 2021).

The purpose of this article is to present the results of qualitative research on the analysis of the relationship between AI and organizational entrepreneurship. AI is analyzed as a tool that supports decision-making processes in the activity of searching for new solutions in an organization, i.e., its activities are referred to as entrepreneurship. The entrepreneurial spirit of an organization is considered as a multifaceted and multidimensional complex of activities and predispositions of the organization's management team, implemented as a process parallel to the organization's life cycle (cf. Glinka & Gudkova, 2011; Maciejewski, Pach, & Śliwa, 2019).

This process aims to generate social and economic benefits, as well as develop the ability to adapt to changing conditions and assess the risk of actions taken. Entrepreneurship is a specific philosophy, the way people operate, the functioning of enterprises. As Piecuch (2013) writes, it is a vast driving force, a factor in the development of individuals, individual enterprises, regions, and entire economies.

The presented paper was inspired by the Accenture report (2019) on the expected trends in digitization, the State of Polish AI 2021 report prepared by the Digital Poland Foundation (2021), the draft regulation on the use of artificial intelligence presented in April 2021 by the European Commission (2021), and also the National AI Strategy, a strategy published by the UK government that defines a 10-year vision of investing in artificial intelligence. In usability studies of AI, particular emphasis was placed on the analysis of the expected effects and requirements of its use. The presented considerations are an element of the research carried out by teams of researchers working under the direction of Kisielnicki on systems supporting the management of organizations. Related to the article are the studies that were presented in the publications: Kisielnicki (2012, 2013, 2017); Olszak

and Kisielnicki (2018); Kisielnicki and Sobolewska (2019); Kisielnicki and Zadrożny (2021).

The structure of the article consists of several elements. The first part, theoretical, defines artificial intelligence and places it in the context of organizational entrepreneurship. The second part, empirical, presents the results of work on the effects and threats of AI applications in the area supporting organizational entrepreneurship. The authors, based on three analyzed cases, present preliminary conclusions from qualitative research conducted on the relationship between AI and organizational entrepreneurship. The research procedure is discussed in detail later in the article.

2. Artificial Intelligence (AI) as a Tool Supporting Organizational Entrepreneurship

Artificial intelligence can be defined in many ways. An analogous problem is related to the definition of biological life, which is complex and multidimensional, impossible to describe with one simple definition (Kuźnicki, 2019). This means that we may have to accept various definitions of AI. In the book Programming a Computer for Playing Chess, Claude Shannon included the theoretical foundations of programming with the definition of the principles of the evaluating function (Shannon, 1950). The first attempts to define artificial intelligence date back to the 1950s. The term was first used in 1956 by J. McCarthy, who described AI as the *science and engineering of making intelligent machines* (McCarthy, 1956). The measure of intelligence is having sufficient abilities and access to professional knowledge to perform a given task (Goleman, 1999).

In addition, what matters here is the ability to function effectively in a given environment to meet specific needs as widely as possible (Albrecht, 2014). Albrecht distinguishes 6 basic categories of intelligence: abstract, social, practical, emotional, aesthetic, kinesthetic. The difficulty of unambiguously assigning intelligence to the machine in human terms will result from its multiplicity. An intelligent algorithm should deal with unexpected circumstances (Batisch, 2018) and choose the best rules of conduct (Tang, Huang, & Bagchi, 2009).

Dynamic technological progress, including increasing the computing power of computers or the ability to store, collect, and use the amount of data (big data), has resulted in a significant increase in interest in the issue in recent years (Yang et al., 2019). Currently, AI is used in many sectors of the economy, including medicine (Hamet & Tremblay, 2017; Secinaro et al., 2021; Abd-Alrazaq et al., 2020), logistics and transport (Boute, 2021), financial services (Cao, 2020), industry (Gade et al., 2019), marketing (Kumar et al., 2019), military operations, security, and ecology (North & Macal, 2007). Numerous applications of AI as an independent

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element of the management process allow assessing its high efficiency and great potential in decision-making processes (Chen et al., 2018; Edwards et al., 2000).

In management research, artificial intelligence is assumed to be a technology capable of (i) interacting with the environment by gathering information from outside (including natural language), (ii) interpreting this information, recognizing patterns or predicting events, (iii) generating results, giving instructions to other systems, or answering a question, and (iv) evaluating the results of activities and improving decision systems (Ferras-Hernandez, 2018). As Michalewicz points out, Business Intelligence (adaptive) can be defined as the discipline of using prediction and optimization techniques to build self-learning decision systems (Michalewicz, 2009). Systems include elements of data mining, predictive modeling, forecasting, optimization, and adaptation. They are used in order for managers to make more accurate decisions and to help in the process of transferring and interpreting information (Bickley et al., 2021). They process information into knowledge (Michalewicz, 2009). They can recognize patterns accurately (Bishop, 2006). Artificial intelligence in business management must have a high level of trust and transparency in operations (Chen & Barnes, 2014). In the medium term, it seems accurate to say that *[o]ver the next decade, AI won't replace managers, but managers who use AI will replace those who don't* (Brynjolfsson & McAfee, 2017).

AI can be implemented through, among others: artificial neural networks that imitate a biological neural network (Gutiérrez et al., 2019), machine learning (Alpaydin, 2016), deep learning (Samek et al., 2019), fuzzy systems (Freksa, 1994; Kruse, 2013), hybrid artificial intelligence techniques (Ko & Cheng, 2003), distributed artificial intelligence (Bond, 2014). Input data can be provided from databases, sensors, by speech, handwriting, or symbols (Batisch, 2018).

According to the authors of the paper, current definitions of artificial intelligence fit into narrow, specialized tasks. Nevertheless, we will define a system or phenomenon as universal artificial intelligence (superintelligence, see also Tegmark, 2015) only when it not only achieves its goals by making decisions, learning, and adapting to changing conditions, but above all when it has at least the majority of features that make up assertiveness, and when it acquires the ability to process common knowledge. This will lead us to rethink the definition and perhaps recognize subjectivity comparable to living beings. Currently, we will call each IT system that allows you to decide by transforming information into knowledge artificial intelligence. Depending on the type and advancement, including in applications in an organization, we will classify it into one of the levels from 1 to 5, discussed later in this article. In the case of superintelligence (universal intelligence), we will scale up and categorize level 6 as a completely new phenomenon in entrepreneurship.

3. Organizational Entrepreneurship

Organizational entrepreneurship consists of two types of phenomena and processes complementary to them: the birth of a new enterprise within a functioning organization, i.e., internal innovation leading to new or improved ventures; and reorientation of an organization by renewing the main ideas and goals on which they are built, i.e., strategic revival (Guth & Ginsberg, 1990).

Attempts to define and parameterize entrepreneurship, including corporate entrepreneurship, already have extensive literature. Dyduch, synthesizing the definitions of this concept, distinguishes between related groups: entrepreneurship; organizational entrepreneurship; internal organizational entrepreneurship; entrepreneurship within an existing organization; venturing; entrepreneurial ventures in an organization; internal entrepreneurship (intrapreneurship). As organizational entrepreneurship, he indicates a phenomenon in an organization that is characterized by innovation; flexibility; dynamism; creativity; propensity to take risks; recognizing and seizing opportunities. Dyduch assumes that organizational entrepreneurship is a phenomenon that contains competitive behaviors that are carriers of market processes (Dyduch, 2008). Schumpeter considers entrepreneurship as the process by which the economy as a whole moves forward (Schmpeter, 1934). Entrepreneurship is a process by which companies recognize opportunities and act (Jones & Butler, 1992). It enables the expansion and reorientation of business profiles. The main features of the organizational entrepreneurship process are the use of internal resources, the expansion of knowledge and competencies in new areas, and the initiative of employees (Belousova et al., 2021). Organizational entrepreneurship emphasizes the birth of innovative ventures within an organization (internal companies) in many forms and sizes, which can have a significant impact on the revitalization of an organization and the creation of something new, competitive, and effective.

Entrepreneurship in organizations is worth measuring because it is a premise of organizational effectiveness. The fact that entrepreneurship is an element of management is pointed out by Dyduch (2015), who writes that effective management can be achieved by measuring and stimulating entrepreneurship. One should agree with Bratnicka, who believes that innovation is part of organizational change and that the interaction of innovation and change is primarily used to implement innovation (Bratnicka, 2015). Entrepreneurship includes innovative changes. Organizational innovation begins with creative ideas (Bratnicka, 2014). Many organizations are increasingly looking for methods to implement organizational entrepreneurship to combat lethargy and bureaucracy, which are quite often combined with the large size of the company (Thornberry, 2003). To support technical organizational entrepreneurship, dimensions of micro-job design and intrinsic motivation to innovate need to be considered (Marvel et al.,

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2007). Companies in Silicon Valley, such as Google, attach importance to entrepreneurship and corporate innovation (Finkle, 2012).

As Anthony notes, the list of big companies that have launched paradigm-changing innovation is significant. Thus, they contradicted the popular idea that most corporations are simply too big and purposeful to create breakthrough inventions. Facebook, IBM, Unilever, and Microsoft show that slow innovations of large companies have become obsolete. Companies do not restrain innovation and even promote it strongly. Thus, it will be organizational entrepreneurship (Anthony, 2012).

Organizations using organizational entrepreneurship do not take the external environment for granted (Morris et al., 2011). They treat organizational entrepreneurship as a growth strategy (Zahra et al., 1999). This means that innovation and proactivity, combined with the important role of intrapreneurs and champions, increase the chances of an organization's success (Bagheri et al., 2020). The strategy of engaging in a continuous process of entrepreneurial activities is aimed at achieving a competitive advantage (Kuratko & Morris, 2018).

Organizational entrepreneurship is a multidimensional phenomenon. It can be assumed that its main models are: cognitive (Dutta & Crossan, 2005); behavioral (Hayton et al., 2002; Krawczyk-Bryłka et al., 2008); procedural (Clausen, 2020; Morris et al., 2010); entrepreneurship assessment (Dyduch, 2008); entrepreneurial renewal (Dyduch, 2015); integrated (Morris et al., 1994); classic/conceptual (Goosen et al., 2002); based on opportunities (Shane & Eckhardt, 2003); digital (Badzińska & Wyrwicka, 2020); acceleration (Chesbrough & Crowther, 2006); humanitarian (Parente et al., 2021).

Based on the literature analyzed in the article, the definition of organizational entrepreneurship, in the context of implementing AI tools, is all social processes, methods, events and operating styles in an organization, characterized by:

- seizing opportunities and being proactive;
- the birth of a new enterprise within the organization;
- gathering innovative internal resources related to the improvement of undertakings;
- the reorientation of the organization by renewing the core ideas and objectives;
- strategic renewal;
- increasing competitiveness;
- increasing efficiency;
- taking the risk associated with entering new areas.

The implementation of artificial intelligence-based management tools is an innovation and an example of organizational entrepreneurship. Kai-Fu Lee (former president of Google China) points to a significant feature of current methods of creating artificial intelligence algorithms, namely that

the average engineer will get better results than the best expert if only the former has access to a good quality database (Lee, 2019). According to the authors, the thesis that artificial intelligence tools can have a significant impact on organizational entrepreneurship is legitimate because: (i) they will not be reserved only for a narrow group of entrepreneurs; (ii) they have the potential to explosively implement innovations in enterprises and change the management paradigm**.**

Progress in big data processing with the use of artificial intelligence undoubtedly presents new opportunities for organizational entrepreneurship. High-level artificial intelligence (as an element of DARQ, Business Intelligence, Media Intelligence, or other ICT systems that cover the entire organization) is a support tool for organizational entrepreneurship.

4. Research Procedure

The following research procedure was applied:

Step I – analysis of the literature review, which was carried out in the following three groups:

- Artificial intelligence (AI) – works on the effects and risk of applications (cf. Abd-Alrazaq et al., 2020; Chen et al., 2018; Tegmark, 2017; Bostrom, 2017).
- Entrepreneurship – papers on information needs and model applications both in traditional and network organizations (cf. Drucker, 1998; Bratnicki & Strużyna, 2001; Westhead & Wright, 2013; Piecuch, 2013; Łochnicka, 2016).
- Scientific research methodology – studies on qualitative research (cf. Wieczorkowska & Wierzbiński, 2007; Czakon & Glinka, 2021).

Step II – qualitative research on the effects and threats of AI applications.

The purpose of this study was to identify the effects and concerns of entrepreneurs related to the decision support procedure in entrepreneurial activity. A group discussion focused on the effects and risks of AI technology applications was conducted. The respondents were asked to answer the following question: What do you consider as the effects and what are you afraid of in the application of AI technology as a tool supporting entrepreneurship?

Research on AI applications in the organization was conducted in April 2018. The focus group consisted of approximately 30 people. The discussion was conducted by J. Kisielnicki in the classes of Computer Science in Management at the MBA studies at Lazarski University. The participants in the group were people with higher education (6 of them worked as IT specialists in the ICT division). Most of the participants (25 people) were mid-level managers with at least three years of work experience and had completed higher education.

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Step III – Development of synthetic tables based on the literature and the results of the qualitative focus group study.

Step IV – Nine experts were selected, five of whom are Ph.D. holders in management and four Ph.D. candidates with advanced doctoral dissertations in management. Five people had a technical background (graduates from polytechnic universities). The experts had at least 10 years of experience in the domain of ICT applications.

Step V – Sending the forms to experts for evaluation and modification. Processing of results and their presentation.

Step VI – Case analysis and action research. Preliminary results of the research have been published. This research is currently being carried out by us. The selection of the organizations results from the direct relations of the authors with the organizations analyzed.

The case study research pursued the following research questions:

– Do current IT systems have modules that can be considered to meet the requirements of AI technology?
– In which organizational areas do respondents see the potential of using AI?
– What is the current level of advancement of AI applications in the organization?

  The assessment uses an analogy to the categorization commonly accepted in the industry (SAE International, standard: J3016_202104, edition 2021), where the following can be distinguished:
  - Level 1 – the lowest level of automation (here, AI applications);
  - Level 2 – advanced support system, but the system is operated by a human at all times;
  - Level 3 – the system makes its own decisions, but is constantly supervised and adjusted by a human;
  - Level 4 – the system, in most cases and during normal operation, does not require any human interaction, but its operation still can be manually adjusted;
  - Level 5 – the system does not require human intervention and can do more than an experienced operator.
– What are the future plans for ICT development, including AI implementation in the organizations surveyed?

The case analysis was conducted in the following organizations:

1. Polish Public Television (PPT) is a public television broadcaster. It has been operating since 1952. AI technology is widely entering television production and is anticipated in the latest investments. Existing production processes, often supported by analogue technologies and large operator teams, are being replaced by automated AI-assisted digital

processes. In particular, in the areas of robotics and studio automation; image recognition (e.g. cleaning and replenishing damaged audiovisual productions; pre-selecting production materials; tracking objects; recognizing and removing prohibited content); the use of Augmented Reality (AR) and Extended Reality(XR).
2. ORLEN KolTrans S.A. is a company in the railway industry. It has been operating since 2001. Since 2019, 100% of the shares have been held by the Capital Group of Polski Koncern Naftowy ORLEN S.A. It offers a comprehensive service in the field of rail transport, including domestic and international transport, rolling stock maintenance and repair, car lease, siding service, and forwarding.
3. Andrzej Trenda Transport and Forwarding is an enterprise in the transport industry. It has been operating since 1987. It offers truck transport services. Its fleet includes approximately 100 lorry vehicles manufactured by Volvo and Man. In addition, the company also deals in other forms of activity, such as wholesale and retail sales of passenger cars and vans.

5. Findings

As a result of the discussion on the materials obtained from the analysis of literature and own research, synthetic tables on the effects and expected risk of using AI in the organization were developed. These studies were supplemented by the evaluation of the obtained results by experts. The results of the discussion and expert evaluation are presented in Table 1 in the following four categories: technical, economic, social and legal.

Table 1
Expected effects and threats from the use of artificial intelligence in the area supporting organizational entrepreneurship

Category	Effects	Expected threats
Technical	– Faster decision-making process. – Access to big data. – Technical capabilities to solve crucial problems. – Process and decision-making optimization at various management levels. – Replacing people in various positions. – Improving the quality of the communication system between individual elements of the management system. – Ability to use very complex algorithms and heuristics. – Ability to process large data sets. – Overcoming geographical barriers.	– Measurement errors. – Algorithms have not been mastered. – Self-learning algorithms can take control of some processes. – The risk of failure during calculations. – Fraud, i.e. use by unauthorized people. – Creating conditions for opportunistic behavior. – Data manipulation (fingerprints, genomes, etc.). – The risk of data leakage. – The risk of using uncontrolled technology. – Limited availability of broadband internet.

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Tab. 1 – continued

Category	Effects	Expected threats
Economic	– Improving the quality and efficiency of the organization's functioning. – Possibilities of objectifying decisions. – Possibility of analyzing development trends of various, often very complex, objects. – Possible reduction of costs at all stages of the organization's activity. – The emergence of new business models. – A closer relationship with the client (i.e., contact anywhere, anytime). – Improving the decision-making process (for example, by better understanding customer needs). – Reduced cost of accessing and processing information. – Predicting/analyzing risks and preventing their occurrence. – Standardization of, for example, communication and the opportunity to use twenty-four hours a day.	– Requires skills (training) of the user. – Technology malfunction. – Asset loss as a result of incorrect and overdue decisions. – Greater dependence on external suppliers of models, data, and equipment. – Lack of trust in new technologies, and thus the results of AI calculations.
Social	– More complete and comprehensive advice to entrepreneurs. – Eliminating traditional and time-consuming activities for the use of AI. – Possibility of using dedicated dashboards at different management levels. – Simulate the effects and risk assessments of various social development strategies. – Improving the quality of information systems, including the opportunity of using global knowledge bases. – Eliminating barriers (e.g., by supporting people with disabilities, speech and hearing aid, etc.).	– Using specialized personal data protection systems. – Highly qualified technical and operational personnel. – Dependence of society on technological solutions – The anonymity of decisions and the lack of opportunity for discussion. – Ethical aspects of the decisions made. – Elimination of workstations.
Legal	– Objectification of decisions. – Automatic analysis of legislation across a broad spectrum.	– The anonymity of decisions makes it difficult to identify the person responsible for making the wrong decision. – Omission of relevant legal provisions.

Source: Own work based on conducted research.

When analyzing the features of AI technology listed in Table 1, the following should be emphasized:

1. The characteristics of both the effects and the threats are qualitative. The description of AI has no classification features (unambiguity and completeness), and in the future, after a complete analysis – and not a pilot one, as it is now – more utilitarian recommendations should be put forward. It is also difficult to determine the weight of individual elements using the adopted test procedure. Research in this area will continue.
2. AI technology that supports organizational entrepreneurship can be implemented by almost every company in Poland. AI is an opportunity for small businesses in this regard. Small or family entrepreneurs, or those based in small towns, can access a wide range of advanced business models with a relatively low financial investment. In this way, they can gain a competitive advantage. The analytics of this data in its basic form is provided free of charge and is relatively inexpensive. Thanks to improved direct communication, entrepreneurs can conduct effective marketing activities, building their credibility and loyalty among customers.
3. Currently, advanced AI is not fully used. It is difficult to fully assess it, both in terms of effects and threats. The application is costly, and with the introduction of DARQ (Distributed Ledger, Artificial Intelligence, Extended Reality, Quantum Computing) technology solutions, it will require fundamental changes in the management infrastructure. Investing in AI in its basic form is relatively low-cost, while its advanced forms are capital intensive. They require not only specialized infrastructure, but also highly qualified personnel.
4. The research presented in this section should be continued and extended, including quantitative characterization of AI applications, especially those concerning effects and costs. Such research will provide recommendations for organizations as to the legitimacy of spending on hardware, software, and user training in the use of AI as a tool to support the enterprise's organizational entrepreneurial activities.

6. Case Analysis, Qualitative Research in Selected Organizations

Below, we present the results of the developed case analysis:

6.1. Polish Public Television (PPT)

Polish Public Television (Telewizja Polska S.A.) is a Polish public television broadcaster, a joint-stock company of the State Treasury, the functioning of which is regulated by the Broadcasting Act of 1992 (i.e., Journal of Laws of 2020, item 805). The IT systems have modules that can be considered to meet the requirements of AI technology at levels 2 and 3.

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In the case of news television, the production processes can be divided into the following main areas:
- Journalistic (news) systems are applied to prepare materials and parameterize the edition, by planning the broadcast day.
- Editing systems for audiovisual processing.
- Production systems for the use of directors and studio infrastructure.
- Broadcast systems to handle the signal transmission.
- Auxiliary systems for material management (MAM-Media Asset Management), Archive, AQC (Auto Quality Control), and other supporting subsystems.

However, this division will never be sharp as the systems interpenetrate and cooperate on shared databases. Each of the areas has modules that can be considered to meet the requirements of AI technology. The possibility of its application in the television production environment is becoming increasingly apparent. In the media, these techniques are particularly evident in content management, where tools for recognition and advanced image and sound analysis, automation of description, and content categorization are already available today.

Techniques related to the analysis of large data sets allow the observation of certain behaviors or trends. In addition, technologies allow for the personalized display of advertisements in linear live transmissions or VOD (video on demand) for the user, by combining the sender's stream with the content of an individually dedicated advertisement.

There are already the first commercially available systems with AI algorithms, on the border of implementation, assembly, and media resource management (e.g. IPV Curator, Mobile Viewpoint IQ vPilot[1], Pixellot AI-Automated Video and Data) enabling the implementation of the material according to the given criteria. Polish Public Television is considering such systems to be used in simple productions.

Significantly advanced are the systems of automatic reconstruction of damaged productions, using AI to recognize film damage, make a correction, and supplement image content with missing elements.

Another developed example is systems for automatic quality control of materials and for classifying them in terms of content-related correctness. An example of this type of AI algorithm may be the automatic control of forbidden content, such as the visibility of alcohol during prohibited broadcasting hours.

Another element is intelligent MAM (Media Asset Management) systems, which can locate audio/visual materials in archives based on a given description, e.g. the image of a person or the scene being searched, which significantly speeds up and facilitates work.

Audience measurement (telemetry) systems are also an important area, as a fundamental element by which broadcasters are account for

the broadcasting of materials, including advertisements. These systems are equipped with AI elements to improve their precision.

However, no integrated autonomous systems have yet been implemented, with a complexity as high as the entire production process. The available technologies and methods are the seeds of future ways to manage these processes. The work on AI focuses only on single areas.

The area of greatest development potential is the production systems that support the studio infrastructure. A typical news studio is operated by, among others: a publisher; executor; edition editor; graphic designers; camera operators; sound operators; support for the plan and scenography. The application of each subsequent level of autonomous work with AI will reduce the number of people needed to complete the release.

Today, Polish Public Television plans to concentrate the available production tools at level 2 or 3. It is a temporary level, as the system in selected areas will evolve to level 4 or even 5. Then, the different production areas will also be integrated. However, it should be stressed that level 5 is currently not technically achievable.

It is estimated that moving from level 2 to level 3 in the field of television production (studio and director's department) will reduce the number of employees from approximately 11 to approximately 4 for a single news program. The costs of the system will pay off in about two years. Achieving successive levels will have a smaller and smaller effect of avoided expenses, but the system will improve itself by moving to more and more autonomy. Such changes are associated with a conflict of interest inherent in innovation. On the one hand, we have teams of people and their workplaces, and on the other, innovation and increased production efficiency. In PPT, changes are taking place systematically, e.g. by replacing retiring people with automation and AI and using the most modern solutions in new productions. Figure 1 shows a diagram of a modern news program organization at the third level of automation, which is planned to be implemented in PPT.

New construction projects for Polish Public Television have the latest technology in their "DNA". They take into account the high-performance requirements of buildings. The existing facilities have ineffective room layouts, energy and cooling systems. PPT also uses the services offered in the cloud (an example is the Microsoft office application environment), including simple AI modules such as Power Automate or AI Builder, as part of the office suite. Further functionalities are being considered with the use of cloud services.

The first quantum computers are commercially available (but still prototypes) as are open-source developer tools for preparing quantum algorithms. In the target model of level 4 or 5, Polish Public Television considers the application of quantum computer technology to support the computational production environment, e.g. for the needs of AI algorithms. It is currently difficult to determine what exact applications this technology will have, but it is legitimate to assume that in 10–15 years it will be widely available and will allow for

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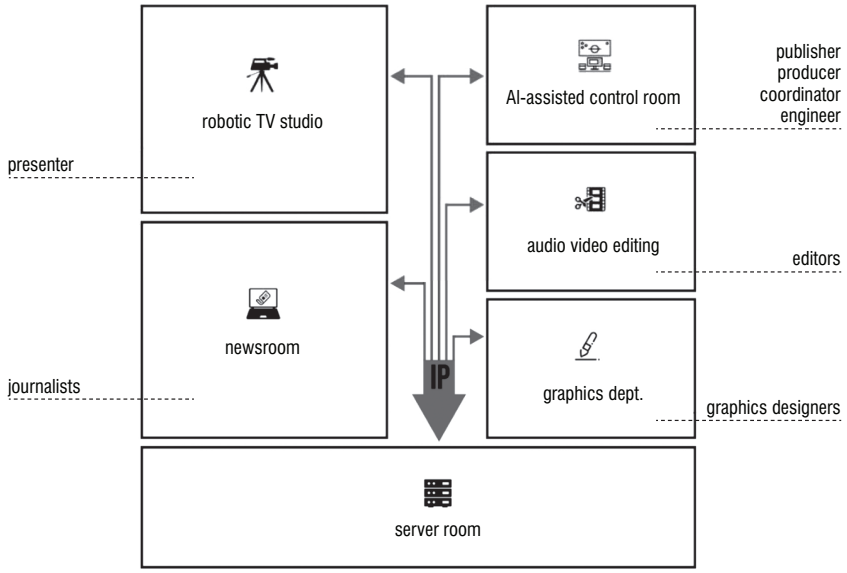
computational possibilities currently unachievable. These may include complex decision problems, search and optimization problems, which are very numerous in television production processes. The television archive includes nearly 100 petabytes of audiovisual production and other data. Examples of this technology are as follows: IBM Q System One, Microsoft Azure Quantum[2] with partners, Google Quantum Computing Service, or D-Wave[3] systems. Quantum technology can be used in the cloud or as your own unit. PPT estimates that quantum computers will add a new dimension and cause AI acceleration. It is justified to build programming competencies, as they are completely different from the current programming method. Basing them on quantum phenomena requires the development of new competencies.

Figure 1
A diagram of modern work organization of a news program



Source: Own work.

In the first stage, the quantum computer has to be integrated with the central production environment using quantum development tools, such as Qiskit, IBM Quantum Composer[4], or Microsoft Quantum Development Kit. It is planned to investigate the opportunity of implementing this technology in AI applications. Today, technology has high requirements for working conditions. Nevertheless, the possibilities it offers are worth further in-depth analysis. The current cost of the quantum unit is likely to decline significantly

and become more widely available for commercial purchase over time. It is estimated that the expenses of the quantum unit will initially oscillate around USD 10 million, which is equivalent to the cost of equipping a medium-sized modern TV studio. With the exponentially growing amount of data to analyze, especially audiovisual data, and the necessity to process it quickly, such an investment may prove indispensable.

In PPT, entire teams are appointed, including more than 50 people, whose task is to implement technologies with AI modules, including research on how to implement it. It is a significant element of the future of the company and its investments.

6.2. Orlen KolTrans S.A.

Orlen KolTrans S.A. (Orlen KolTrans) is the largest Polish rail carrier. It belongs to the PKN Orlen capital group. Orlen KolTrans is engaged in the transport of liquid fuels in Poland, service and repair of rolling stock, rental of wagons, forwarding, as well as management and maintenance of sidings. Its overall shareholder is Polski Koncern Naftowy Orlen S.A.

The IT systems have modules that can be considered as meeting the requirements of AI technology in the following areas:

- Integrated Quality Management System according to ISO 9001: 2008, Environmental ISO 14001: 2004 and Safety PN-N-18001: 2004.
- Safety Management System (SMS).
- Maintenance Management System (MMS).

The Maintenance Management System allows us to support decision-making processes related to both processes taking place in the company and integrating the system with other systems of the company.

Modules that perform the functions of AI are elements of an integrated ERP class system. It is difficult to identify an AI module as the primary one. Most often, they are elements of the entire KolTrans management support system in such modules as:

- IRP Infrastructure Resource Planning;
- SCM Supply Chain Management;
- EAM Enterprise Asset Management;
- TMS Transport Management System;
- GIS Geografical Information System;
- CRM Customer Relationship Management;
- BI Business Intelligence.

We do not have sharp boundaries between systems that support the management of logistics processes and other systems that support various forms of organization management. Based on an in-depth analysis of subsystems, we can assume that, following the typology previously assumed, we currently have AI applications at level 2 with elements of level 3. Knowing

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the development programs of ICT technology at Orlen, we can assume that this is a transitional level because as part of the use of e.g. machine learning, the system in selected areas will evolve to level 4 similar to the Polish Public Television case analysis discussed above. We believe that level 5 is currently technically unattainable. The existing AI modules allow one to get answers related to logistics management, such as:

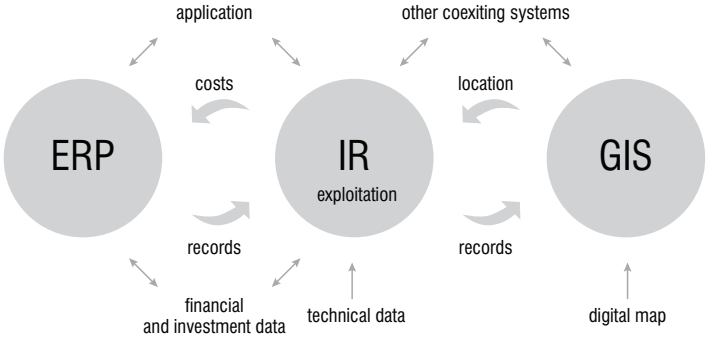
– How to improve existing processes?
– When should tankers be replaced or refurbished and how much does it cost?
– To what extent does tank management support business goals?
– How to plan tank routes to reduce operating costs?

Most of the information obtained as a basis for the decision whether it is level 2 or 3 is spatially referenced as physically all the elements of the transport infrastructure are located throughout the country. Accurate information on a given device and its location, the history of this device and the possibilities of improving the existing condition allows for a faster response in emergencies and crises. In addition, it supports the daily use and periodic service work. This facilitates effective operational management of the transport base and related infrastructure. AI modules are powered by data that is available in an electronic or paper form. AI will be integrated into one module of the Integrated Organization Management System.

It is expected that in the future AI modules will operate in the TMS (Transport Management System). TMS solutions will support the handling of tank car movement processes. The process analysis in Kol Trans with the use of AI tools enables the communication between business process participants and the company's customers. The future intention is to develop and monitor these arrangements by the so-called virtual agents. The current IT system is adapted to the requirements and procedures in force in the European Union. Tank information is available in real time, which allows making corrective decisions with existing algorithms.

KolTrans is interested in making decisions both in terms of the train composition and individual tanks, that is, their load, timing, and composition. The main element is the recording of events that take place in the process of forming and dispatching the train, events that take place during its movement, and the event related to the departure and arrival of tanks on the Polish railway network. Another aspect of the study is the management of the operation of both own and third-party tanks, both in financial and operational terms. Current decision-making is based on the online monitoring of the entire fleet management system. The basis of the monitoring process is, on the one hand, the desire to improve the quality of services offered and, on the other hand, the desire to reduce the running costs of the company's operations and eliminate risks. These goals are consistent. The functioning of the information system in KolTrans is shown schematically in Figure 2.

Figure 2
Interoperability of ICT elements in KolTrans



Source: Own work based on materials from the Architects Team of Rail Transport Solutions. ERP, Enterprise Resources Planning; IRP, Infrastructure Resource Planning; GIS, Geographic Information System.

Regarding the future of ICT and AI modules development, it is currently not possible to obtain detailed information, as Orlen is to be merged with Lotos. The latter has a larger fleet of tanks and has its own solutions, not always compatible with KolTrans' ones.

6.3. The Company Named *Trenda Andrzej Transport and Forwarding*

Andrzej Trenda Transport and Forwarding is a family company owned by Trenda Andrzej, Trenda Marcin and Trenda Szymon. The company is headquartered in Stęszew in the Greater Poland Voivodeship. The company has been operating on the market since 1987. The company provides products in the following sectors: car transport, domestic, and international truck transport. The company is one of the largest family transport companies operating in the field of international transport. It has over 100 trucks in its fleet, mostly VOLVO and MAN.

Information systems have modules that meet the requirements of AI technology, generally at level 2.

The main advantage of using ICT are improved operational fleet management. ICT allows the fulfillment of an advanced support system in the field of operational management, but the system is still operated by a human. IT systems enable: implementation and identification of standard processes with corresponding account charts; integration with the majority of computerized customs systems in Europe enabling the exchange of customs documents; supporting NCTS (New Computerized Transit System) standards and developing comprehensive customs reports; cost-benefit analysis for a single shipment order, driver, vehicle. Information and Communication Technologies allow inventory and management of the entire fleet. The

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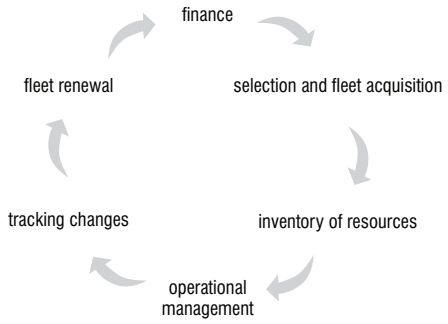
concept of the system is based on the vehicle fleet management cycle, which consists of the following modules:
- Finance – evaluation and creation of financial models facilitating the decision-making on the choice between different variants of the order execution;
- Selection and acquisition of a fleet component – planning tools and a database containing full cost data from the entire life cycle of the vehicle;
- Inventory of resources – complete information about resources, changes and availability;
- Operational management – management of spare parts, service, tools enabling fully active fleet management;
- Track changes – tools and database to compare the cost and performance of individual assets;
- Fleet renewal – sale, settlements with suppliers of vehicles, replacement at dealerships or scrapping.

Figure 3
The fleet management cycle at Trenda Andrzej Transport and Forwarding



Source: Own work based on conducted research.

According to the President of the company, Andrzej Trendy, the future of AI applications is an autonomous car (also called: driverless car or unmanned land vehicle) – "a motor vehicle equipped with systems that control the movement of this vehicle and enable its movement without the driver's intervention". The President refers to the report titled Autonomous Transport of the Future, developed by experts from the Polish Economic Institute and the Ministry of Infrastructure (2020). This position is in line with the position expressed in the cited report that the development of artificial intelligence affects many sectors of the economy, but two clear leaders can be noticed: the telecommunications and transport industries. Among the areas of technology development in transport, patents related to autonomous vehicles are leading,

followed by intelligent traffic management systems, driving simulators, and recognition technologies – both related to the development of road autonomy. Patents in the telecommunications area are often related to autonomy in transport, which requires modern communication technologies between vehicles.

7. Conclusions From the Conducted Research

The results allow us to conclude that broadly understood AI modules support the decision-making process. By attempting to find a synthetic answer to the previously asked questions, we can say that the interviews with the management staff confirm the opinions obtained in the focus group research. Thus:

1. Do IT systems have modules that meet the requirements of AI technology? There are no dedicated modules assigned to AI. Most of the modules concern the acquisition of data necessary to make decisions in the operational activities of companies.
2. In what organizational areas do the respondents see the potential of using AI? Most of the organization's management does not have complete information about AI applications. The possibility of application ICT is significant, especially in operational activities in the context of the exploitation of owned resources and financial services. They do not realize the specificity and needs of applying the AI theory in practice. The case analysis of Polish Public Television seems to be an exception.
3. How can you assess the current level of advancement of AI applications in the organization? According to the assumptions adopted and the categorization, most applications consist of data preparation and the application of an advanced management support system. However, the decision-making process is run by a human and corresponds to level 2. Only occasionally does the system make its own decisions, but it is constantly supervised and corrected by a human (level 3). In the case of the Andrzej Trendy company, when driving single units of the car fleet and experimentally during regular work (driving a car), it does not require any human interaction. However, its operation can still be manually corrected (level 4).
4. What are the plans for ICT development, including the implementation of AI in the organizations analyzed? There are no separate plans to implement AI in the organizations surveyed. The policy related to the development of AI is part of the overall development of ICT. The most ambitious ICT development plans are in PPT, which is currently implementing an IT infrastructure development project and allocating significant funds for this purpose. The logistics organization KolTrans is undergoing organizational changes, while Andrzej Trendy's company plans to develop through new cars. In the case of subsidies, development will include autonomous cars with AI modules in the software.

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Artificial intelligence is an effective tool for supporting organizational entrepreneurship in the area of innovation, which is its essential component (Dyduch, 2008). It is also a significant element in building and maintaining a competitive advantage, which is well illustrated by the case study of Polish Public Television. Each of the discussed organizations is at a different stage of implementing AI modules, while the common point is both the management's focus on searching for opportunities and implementation of innovative solutions. A major effect of implementing AI is to generate new development opportunities and verify procedures performed.

As mentioned in the Introduction, the presented work should be treated as an introduction to further research. It is planned to conduct qualitative research on a larger sample with several research questions that arose during the presented work, that is, (i) What is the level of awareness about the implementation of AI in the context of organizational entrepreneurship in Polish enterprises? (ii) What is the relationship between the implementation of AI modules and the company's financial performance? (iii) Is there a relationship between the organization's innovativeness and its size? (iv) Does the organization have a dedicated budget for the implementation of new IT systems?

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Endnotes

1 https://www.mobileviewpoint.com/vpilot/ [accessed: 6.09.2021].

2 https://azure.microsoft.com/pl-pl/solutions/quantum-computing/#quantum-impact [accessed: 7.09.2021].

3 https://www.dwavesys.com/learn/resource-library/ [accessed: 7.09.2021].

4 https://www.ibm.com/quantum-computing/tools/ [accessed: 7.09.2021].

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