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INTEGRATED STRATEGIC MANAGEMENT, PORTFOLIO, PROGRAM, AND PROJECT MANAGEMENT

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For lecturers, researchers, postgraduates, students, and professionals.

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PROJECT MANAGEMENT IN THE GREEN ECONOMY: A CASE WITH HIROSHI TANAKA

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According to project management research sources, 40 to 50 % of the World GDP is contributed to by project-driven economic activities in 2010's and on. Also, 63% of the world's, 62% of Ukrainian, 77% of USA's and 71% of Japanese GDP come from service (CII Word Factbook, 2024). Contemporary service in the developed and transition economies is characterized by knowledge utilization and the green economy mostly in the environment of the New Normality of which elements consists of unpredictable world, climate change back-to-back with green society and green economy, disruption, digital transformation and social transformation, chain of Pandemics and epidemics, human or society centric development, agility of corporate enterprises, food, energy and water divide, and displacement of population, either forced by wars and other difficulties or seeking better opportunities (Tanaka, H., 2022). Hence, we need to argue how projects in the green economy differ from traditional projects and how project modeling for green economy projects should proceed.

A generic comparative analysis on the two generations of projects reveals that on traditional projects, engineering in multiple disciplines such as civil, mechanical, electrical, control, etc. are utilized; a chemical process engineering or mechanical process engineering serves for systems integration; project creation has proven routines; funds come from corporate finance, or bank loan, or development agency funds by the World Bank, ERDB, JICA etc., project finance, Public Private Partnership (PPP) or Build-Operate-Transfer (BOT); and global project management standards can work for the project implementation phase of projects, whereas on green economy projects, environmental engineering, the circular economy model, the sharing economy model, reverse innovation methods, well-being modeling are used additionally; for energy transition, we still need chemical and bio engineering for systems integration and for other green economy projects, we use soft systems approach and design thinking; project creation often requires zero-based or breakthrough thinking; funding for green projects also utilizes corporate finance but may mostly be combined with green finance provided by the government, transnational development finance institutions or CSR funds of large corporations; global project management standards do not work well in the green economy projects as they do not include project conceptualization and development process; often political leadership is a driver on major climate change response projects. provided by global project management standards.

Against this environmental scan, fine-tuned project modeling is crucial on green economy projects while processes provided by global project management standards do not cover project modeling. In this report, project modeling is argued in

the order of 1) a project system prototype model which is a versatile project model and treats a project as a system of conversion in which a project intakes input resources from the environment ecosystem characterized by PESTLE (political, economic, social, technological, legal and ecological) factors and produces output resources realizing certain outcome given by the project master plan. The project realizes this conversion by means of enabling means such as technology, finance and project management processes equipped in the project; 2) two project conception tools which help visualize project conception against the backdrop of the project prototype model mentioned above by a “as-is” to “to-be” analysis to map routes to solve problems with the current model and to arrive at the desired state as well as a cause and effect diagram, or Ishikawa diagram, to conceive how to arrive at a project concept satisfying the desired state by identifying elements which contribute to attaining the concept of the projects by classification of economic objectives, differentiation factors, resources to be utilized, element technology and points of systems integration, and risks; 3) mechanism of project modeling contained in the project system prototype in which against a project mission and its translated main objectives and constraints, project definition and substantiation proceed from project basic function analysis, through enabler means analysis and stakeholder analysis back-to-back, and cost analysis, to finance planning until arriving at a tentative project plan formed after a project’s feasibility study, which, then, undergoes through sensitivity analysis of alternatives and a final project plan is selected; 4) program management approach useful for multi-purpose, multi-discipline and multi-stakeholder projects which help integrate analysis in terms of application areas, sense-making from policy and strategy, finance, and enabling means which for instance in climate change response projects, include eco and smart technology, digital transformation, circular economy model and sharing economy model; and 5) collaborative study disciplines which can be referred to supplement project management in the green economy such as knowledge science, service science, ethnography, environmental studies and public administration.

Finally, a case study on the waste-to-energy project is presented as an exceptionally reliable environmental protection solution to dispose city wastes with least CO₂ emission while generating electricity for sale.

THE APPLICATIONS OF GENERATIVE ARTIFICIAL INTELLIGENCE IN PROJECT MANAGEMENT

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The rapid evolution of technology has brought about transformative advancements, with generative artificial intelligence (AI) emerging as one of the most impactful innovations. Generative AI, characterized by its ability to create content, generate solutions, and predict trends based on large datasets, is increasingly being integrated into various industries, including project management. This essay explores the applications of generative AI within the realm of project management, highlighting its potential to revolutionize traditional practices. By automating repetitive tasks, optimizing workflows, and enhancing resource allocation, generative AI enables project managers to focus on strategic priorities and innovation. Moreover, its predictive capabilities empower managers to make data-driven decisions, anticipate project risks, and refine strategies in real-time. Generative AI also fosters improved communication and collaboration by producing dynamic reports, drafting project documentation, and analyzing team dynamics. While the benefits of generative AI in project management are significant, challenges such as ethical considerations, data privacy concerns, and the need for human oversight must be addressed to ensure its responsible implementation. By examining the applications, advantages, and limitations of generative AI, this presentation underscores its potential to redefine project management practices, paving the way for more efficient, adaptive, and innovative project execution in an increasingly complex business environment.

In conclusion, generative AI stands as a game-changer in the field of project management, offering tools and capabilities that enable higher efficiency, better decision-making, and improved collaboration. By automating routine tasks, optimizing resource use, and empowering data-driven strategies, generative AI has the potential to redefine how projects are executed in today's fast-paced business environment. However, as its adoption accelerates, addressing ethical implications, safeguarding data privacy, and maintaining human oversight will be crucial to fully harness its benefits. Generative AI represents not just a technological advancement but a paradigm shift in project management practices, paving the way for smarter, more adaptive, and innovative approaches to managing complexity in modern projects.

HOW TO CHANGE STRATEGIC MANAGEMENT LANDSCAPE IN AI ENVIRONMENT?

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Changing the strategic management landscape in an AI-driven environment requires a fundamental shift in how organizations approach planning, decision-making, and execution. Here's a roadmap for reshaping strategic management to thrive in an AI-enabled world. Let's look on the key trends to change strategic management landscape in AI environment.

1. Adopt AI-Driven Decision-Making:
 - shift from intuition-based to data-driven decisions by integrating AI models capable of analyzing vast datasets and predicting trends;
 - use AI for real-time insights, scenario planning, and decision support;
 - deploy predictive analytics to anticipate market changes or customer needs, guiding proactive strategies.
2. Foster an AI-Centric Organizational Culture:
 - embed AI into the organization's DNA by encouraging a culture of innovation and continuous learning;
 - train employees to understand and use AI tools, and reward innovation;
 - implement AI literacy programs to empower employees at all levels to contribute to AI initiatives.
3. Leverage Multimodal AI for Holistic Strategies:
 - use multimodal AI systems to process and synthesize diverse data types (text, visual, auditory, sensory) for comprehensive strategy formulation;
 - analyze customer feedback, competitor strategies, and market dynamics using AI-powered tools;
 - integrate customer reviews (text), sales data (numerical), and social media trends (visual) for a 360-degree view.
4. Enable Real-Time Strategic Adaptation:
 - move from static to dynamic strategy models that adapt in real-time based on AI-driven insights;
 - deploy AI systems for continuous monitoring of key performance indicators (KPIs) and environmental changes;
 - AI alerts managers to shifts in consumer behavior or supply chain disruptions, enabling immediate adjustments.
5. Integrate Ethical and Responsible AI Practices
 - align strategies with ethical, legal, and societal considerations to build trust and sustainability;
 - use AI to assess risks, bias, and the societal impact of strategic decisions;
 - evaluate product launches for inclusivity using AI-driven sentiment analysis across demographics.
6. Reimagine Talent and Leadership Roles:

- develop new leadership paradigms and skill sets to manage AI-centric operations;
- create roles like AI strategy officers or chief automation officers;
- train leaders to collaborate effectively with AI systems for informed decision-making.

7. Build Collaborative Ecosystems:

- shift from siloed operations to interconnected ecosystems leveraging AI-driven collaboration;
- use AI tools to facilitate partnerships and co-creation across industries and geographies;
- AI platforms enable seamless collaboration between suppliers, partners, and customers in a shared innovation ecosystem.

8. Prioritize AI Governance and Security:

- integrate robust governance frameworks to ensure AI is used responsibly and securely in strategy execution;
- establish policies for AI compliance, accountability, and data privacy;
- set up AI ethics committees to review major strategic decisions involving AI applications.

9. Embrace AI-Augmented Creativity:

- use AI to enhance creativity and innovation in strategy development;
- deploy AI tools for brainstorming, prototyping, and exploring unconventional ideas;
- generative AI suggests new product designs or marketing strategies based on user preferences and market trends.

10. Develop Metrics for AI-Driven Success:

- redefine success metrics to include AI's contributions to strategic outcomes;
- measure AI's impact on efficiency, innovation, and competitive advantage;
- track KPIs such as time saved through automation, improved accuracy of predictions, and AI-driven revenue growth.

Conclusion. To change the strategic management landscape in an AI environment, organizations must adopt an agile, data-driven, and ethical approach while fostering innovation and collaboration. This shift empowers organizations to navigate the complexities of the AI era, driving sustainable growth and competitive advantage.

MANAGING INVESTMENT PROJECTS IN CLIMATES OF UNCERTAINTY

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One of the main factors in decision-making by investors is the investment climate of a country. The investment climate is a combination of factors that play a decisive role in attracting investments to the country's economy. The more stable the political environment, the more transparent the legal framework, the more moderate the tax coefficient, and the more attractive the benefits, the more favorable the climate for investors. Some countries have already formed a positive investment image. EU countries, Western Asia, and North America serve as benchmarks for investment attractiveness. However, there are countries currently in the process of forming this image, with new legislative changes made every year to improve investment attractiveness. These countries are referred to as having an uncertain investment climate.

This article analyzes the degree of development of the investment climate and the current level of regional development when entering the investment market. There are various sources and tools for financing projects in the interests of countries.

The article outlines the main areas of direct investment in different sectors that contribute to the economic development and prosperity of the region.

The key tool for direct financing of projects implemented in the interests of investors is the investment strategy and the key investment principles. The investment strategy includes 7 principles:

- compliance with investor goals;
- risk strategy;
- financing format;
- requirements for financial returns;
- approach to project selection;
- degree of operational involvement;
- exit strategy.

The key strategic management principles are the effectiveness of project selection with maximum and focused impact on the region's economy.

When managing investment projects, strategic risks are considered, which involve formulating an overall level of risk appetite at the level of the investment program and cascading it into specific limits for the portfolio and individual investments:

- risk appetite as a vision for managing risks;
- risk appetite at the portfolio level. Cascading the acceptable level of risk at the portfolio level (managing concentration risks);
- risk appetite at the level of a single transaction. Cascading the acceptable level of risk at the level of a single deal and operational management.

The article elaborates on various financing formats, of which the following four key ones are distinguished:

Equity:

- mezzanine financing;
- debt financing;
- income-based financing.

The types of project selection for investment are also examined according to criteria such as:

- «stop-factors»;
- compliance with the investor's strategic goals;
- compliance with financial criteria;
- analysis of other aspects of the investment company's activities.

The models of the degree of involvement of investment companies in the operational management of portfolio assets are discussed:

- passive financial investor;
- active financial investor;
- active strategic investor;
- operational manager.

One of the most important issues in managing investment projects is the exit conditions from the investment. The article emphasizes the key triggers for exiting an investment.

The analysis of these factors allows investors to assess how profitable and feasible the investments are and make decisions on investing in any of the economic sectors.

In conclusion, it can be stated that the analysis of these global indicators allows investors to assess the investment climate in different countries. High indices attract major financial players to the region. This boosts the economy while ensuring high-return investments with minimal risk.

As a feature in climates of uncertainty, it can be noted that investors are increasingly interested not in short-term and risky company stocks or long-term real estate investments, but in investments in modern business. High investment indicators in regions with uncertain climates make local business operations one of the most secure ways to generate profit, making investment in such businesses highly sought after

**THE TRANSFER OF KNOWLEDGE AND TECHNOLOGY FROM
UNIVERSITIES TO BUSINESS IN BULGARIA:
STATUS, PROBLEMS AND POSSIBLE SOLUTIONS**

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The transfer of knowledge and technology as one of the elements in the innovation system and a significant factor for the innovative development of the economy is the subject of encouraging policies by governments in many countries, and Bulgaria is no exception. Intellectual property objects (IPOs) are the tools for implementing technology transfer, and most often the number of IPOs serves to measure the intensity of technology transfer. At the same time, it should be recognized that technology transfer also includes the transfer of knowledge, some of which would be difficult to protect as IPR, and, in principle, this transfer of knowledge is carried out through informal channels that are difficult to be captured by statistics.

The main objective of policies to promote technology transfer is to ensure wider access to scientific and technological achievements by enterprises of different size classes, so that these achievements can be transformed into innovations that increase the competitiveness of both the individual enterprise and that at the industry and national levels.

As can be seen from the data describing research activity at the universities and public research organizations (PROs) in Bulgaria, the main problem facing technology transfer and knowledge transfer in general is the extremely small number of registered IPOs, which are also objects of transfer carried out through formal channels.

Secondly, the interests and capabilities (including the absorption capacity) of enterprises operating in Bulgaria are emerging as a problem for technological transfer and knowledge transfer as well. In contrast to other EU member states and OECD members, SMEs in Bulgaria account for significantly higher shares of gross value added and employment, but with some of the lowest levels of productivity and, consequently, wages. These shares mean that technology transfer should be tailored to the specificities and constraints of SMEs more than in other countries where large enterprises have more significant contributions to the economy. The low levels of value added at each size class, however, would have a dual meaning – on the one hand, they speak of an urgent need for innovations, the achievement of which is unthinkable without technological transfer, but on the other – of severely limited opportunities for investing in IPOs (to pay the transfer price) and for building absorption capacity by hiring highly qualified professionals.

The unsatisfactory state of technology transfer practices in Bulgaria, carried out through formal channels (and also of knowledge transfer, which could also be carried out through informal channels) is largely a reflection of the weak connection between the funding of scientific research activities (SRI) carried out at the universities and PIEs and the creation of IPOs that have commercial potential. Even

stronger is the reflection of the practical non-linkage of R&D funding with the technology transfer carried out.

To promote technology transfer, it is necessary to develop and implement policies for enterprises, primarily SMEs, that would encourage and facilitate their role in technology transfer – active participants seeking IPRs and capable of implementing them in their activities. As an example of such a policy, the idea of linking project funding for R&D carried out by HEIs and PIEs with the active participation of SMEs, represented by their industry organizations, could be considered.

Last but not least, policies promoting technology transfer should focus on training both IPOs creators and entrepreneurs and managers on issues of commercial potential and IPOs valuation. The usefulness of these trainings is expressed in a better understanding of the practical benefits of technology transfer and increased proactivity of the parties in the transfer. It would not be superfluous to develop training to build entrepreneurial and management skills necessary for the creation and management of spin-off companies.

FORMALISING THE FORMATION OF A PROJECT TEAM, TAKING INTO ACCOUNT THE ROLES ITS MEMBERS CAN PERFORM

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There is quite an extensive literature devoted to formalising the formation of project teams [1,2]. At the same time, much attention is paid to approaches to team formation taking into account the knowledge, skills, and experience of candidates. However, it should be remembered that the personal qualities of applicants play a vital role in the team's work. Thus, the leadership style of a project manager can stimulate some participants and sharply repel others; it can give rise to the emergence of groupings that act according to the type 'against whom we are friends'. Bright personalities with high qualifications may be very unfriendly in the team, demand more attention and want to have a very high salary, which will put a heavy burden on the project. A good professional may be an individual player uncomfortable in a team. The list of problems that arise in a team due to the behavioural qualities of its members can go on and on. The question arises. How can the behavioural attributes of applicants be taken into account when formalising team formation? The aim of the paper is to create an approach to formalise the formation of a project team, taking into account the roles that candidates can perform.

There is an extensive literature on models of team effectiveness. Major contributions in this area have been made by Tuckman, B., Beckhard, R., Lombardo, M. M., Eichinger, R. W., LaFasto, F. M. J., Larson, C. E., Hackman, J. R., Salas, E., Dickinson, T. L., Converse, S. A., Tannenbaum, S. I., Patrick L., Robbins S. P., Judge T. A., Katzenbach, J. R., Smith, D. K., Tamiru N. Belbin, R. M., who managed to identify 9 roles that project team members should fulfil, stands out among the famous works. Each team member can fulfil not necessarily one role, but several roles at once. Each role in the team is described by the author, and their strengths and weaknesses are given. The identified roles include Resource Investigator, Teamworker and Coordinator (the Social roles); Plant, Monitor Evaluator and Specialist (the Thinking roles), and Shaper, Implementer and Completer Finisher (the Action or Task roles). The author has developed a questionnaire to assess a candidate's readiness to fulfil a particular role. The questionnaire consists of 8 sections. Each section contains 10 answers. The questionnaire taker should distribute 10 points between the possible answers that characterise him/her best. In some cases, all 10 points can be assigned around one answer. The scores about one role are totalled.

The highest total score a candidate scores indicates how well he or she can perform the role for which he or she is most prepared. Belbin, R. M. has developed a table showing the sum of the scores for each of the roles by which it can be ascertained how much a person's abilities are more pronounced than the 'standard'.

This table shows the ranges of scores for each role: low, medium, high, very high. In addition to self-assessment, Belbin R. M. suggested that an individual be assessed by a minimum of four individuals who have worked with the person for at least 3 months. As a result, at <https://www.belbin.com>, everyone can obtain percentile scores for each team role based on self-assessment and Observers' cumulative perceptions.

To formalise the formation of project teams based on the assessment of the knowledge, skills, and experience of candidates, as well as their readiness to perform certain roles in the team, it is proposed to use the representation of estimates in the form of trapezoidal fuzzy intervals. This representation in comparison with triangular fuzzy numbers allows representing more than one assessment at a time. For example, a Self-Perception score of 72 and combined perception of your Observers score of 81 can be represented by a trapezoidal fuzzy closed interval (segment), which can be interpreted with the following expression: 'the competence score of the j -th candidate on the k -th indicator is approximately in the segment $[72,81]$ '.

It is proposed to find the competence assessments of candidates that satisfy the requirements as the intersection of the belonging functions of fuzzy competence requirements and fuzzy competence assessments. The threshold for the values of the intersection of the belonging functions of fuzzy competence requirements and fuzzy competence assessments is set when reaching which the competencies of a candidate can be considered as satisfying the requirements. It is proposed to form a project team by maximising the sum of dominant competencies, a weighted sum of competencies and minimising the cost of the team taking into account the constraints on the labour intensity of work, on the fulfilment of competence requirements and the cost of teamwork. We applied the generalised function method to solve the multi-criteria problem.

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GREEN SPACE PLANNING IN MODERN CITIES AS AN INTEGRAL PART OF SUSTAINABLE URBAN DEVELOPMENT

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The concept of sustainable development was introduced as a global approach to human progress. In the 21st century, it became a worldwide movement, gaining popularity both internationally and domestically.

Sustainable development aims to shift from uncontrolled growth to a more regulated approach, based on shared principles, constraints, and specific management tools. This ensures economic progress without harming the environment, while promoting social justice and considering future generations [1].

The key principles of sustainable development include:

1. Ensuring a balance between the production-economic and environmental spheres, aimed at achieving a technological level at which economic activity does not harm the natural environment.

2. Establishing a balance between the economic and social spheres, including the maximum use of those resources that ensure economic development in the interests of the population.

The goal of sustainable development for any territorial community includes the following aspects: ensuring adequate social conditions for people, supporting the development of entrepreneurship to ensure its viability, and preserving the natural environment. And this is an urgent issue that does not lose its relevance in modern conditions [2].

Focusing on creating sustainable cities, countries are gradually moving away from traditional solutions in infrastructure, construction, and the organization of the transport system. Instead, they are introducing «green» and «blue-green» components into the urban environment, which help to address climate and environmental challenges.

Many of these green spaces serve multiple purposes and contribute to the quality of life for urban residents. Recent studies have shown that access to green spaces provides people with better health outcomes and helps improve the overall public health and well-being of city dwellers [3].

A green space can be defined as an area within an urban setting that is covered by vegetation and may be publicly or privately owned [4]. Public Health England (2014) defines a green space as an area of greenery, including public parks, playing fields, streets with plants, etc.

Meanwhile, Greenspace Scotland (2008) defines a green space as «any vegetated land or structure, water or geological feature in an urban area».

Free access to good quality green areas plays a key role in achieving sustainability and liveability.

Therefore, the strategy for the development of green areas in a modern city includes

1. The stage of assessing the quality of existing green spaces both in their general condition and in terms of pedestrian and transport accessibility, including the needs of people with limited mobility.

2. The stage of planning new green spaces by transforming so called «grey spaces» with abandoned enterprises into green recreation spaces.

3. The stage of creating new master plans for the urban development, considering the provision of the sufficient space for the location of green spaces.

Researchers have already explored both theoretical and practical aspects of the problems associated with addressing the issue of green space accessibility in cities and specific urban areas [3,5]. This is the focus of the first stage of the strategy.

This paper considers the problem of the 2nd stage of the strategy for the development of green spaces as a optimization geometric design problem [6].

Based on the use of the Accessible Natural Green Spaces Standard (ANGSt) [7], statistical information on urban population density and the topology of urban streets and highways, the geometric parameters of future green spaces are determined within the framework of solving the optimization problem: namely shape, area and possible locations of additional green spaces in urban areas with insufficient accessibility. ANGSt is a UK standard that defines the minimum distance that people need to walk to get to the nearest green space according to city infrastructure.

The results of this study may be useful to urban planners as well as the public for developing future urban plans.

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DEVELOPMENT OF A SPECIALIZED INTERACTIVE PANEL FOR THE TABLETOP ROLE-PLAYING GAME 'TOD'

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Computer games remain a dominant force in the entertainment sector, while board games occupy a niche that often requires in-person gatherings. Recent shifts towards online formats have significantly impacted many industries, including entertainment. For board games, the lack of physical gatherings has spurred interest in online alternatives, potentially redefining the future of this niche entertainment format.

The growing popularity of digital platforms for tabletop games reflects the demand for accessible, virtual analogues. Online resources enable players to connect across geographical boundaries, expanding the hobby's reach and reducing barriers to entry for newcomers.

Objective. The project's primary goal is to develop a virtual game board that enables players to interact on a shared digital map in real time. The panel aims to enhance gameplay accessibility and expand the audience by allowing remote participation.

Comparison with Existing Solutions. The panel offers several advantages over physical board games and existing digital solutions, such as Owlbear Rodeo – a lightweight and intuitive web application that focuses on providing easy and fast use of battle maps for board games such as D&D, P2E, etc. Unlike physical maps, the interactive panel supports remote play, embedded rule enforcement, and persistent progress storage. Compared to Owlbear Rodeo, this project integrates game-specific mechanics, such as ToD rules, and offers advanced features like digital character sheet integration and granular game state control.



Fig. – Example of a virtual map from the Owlbear Rodeo website (<https://www.owlbear.rodeo/>)

Implementation. The virtual game board was developed using Unity's advanced rendering and networking capabilities, ensuring real-time synchronization through Unity Netcode for GameObjects. Predictive state updates and optimistic locking algorithms address potential latency and conflicts during simultaneous edits. Using Unity's Authentication and Relay services, players securely connect to encrypted game rooms, ensuring both data protection and seamless gameplay. Unity

Cloud Code handles game state validation and computational tasks, allowing the application to scale for larger player groups while supporting persistent session storage for pausing and resuming gameplay.

The project implements a lobby system to facilitate group interactions, allowing players to log in securely, create game rooms, and connect via encrypted communication channels without geographical constraints. Dynamic rule enforcement tailored to ToD's mechanics automates calculations for character abilities and resource management, reducing the complexity of gameplay management. This innovation streamlines interactions for the Game Master and enhances the user experience for players.

Innovation. In conclusion, the interactive panel for 'ToD' represents a significant step in modernizing the tabletop gaming experience. It not only addresses the challenges posed by the transition to online formats but also introduces innovative features that enhance gameplay. The product demonstrates scalability for incorporating additional game elements and has the potential to set a new standard in the digitization of TTRPGs. Future development will focus on expanding the feature set, including support for custom game rules and integration with third-party tools for a more immersive experience.

In conclusion, the interactive panel for 'ToD' represents a significant step in the evolution of tabletop role-playing games, bridging the gap between traditional and digital formats. It effectively addresses challenges posed by the shift to online platforms, introducing innovative features such as dynamic rule enforcement, cloud-based scalability, and persistent session storage, which enhance both accessibility and gameplay.

The product's modular design and integration of ToD-specific mechanics demonstrate its adaptability and potential for further development. Future improvements will aim to expand functionality, including support for custom game rules, integration with third-party tools, and the adoption of advanced technologies such as augmented reality and AI-driven mechanics to create a more immersive and engaging experience.

PLANNING AND MANAGEMENT OF THE ORDER PORTFOLIO AND DEVELOPMENT PROJECTS OF CONCRETE PLANTS

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The restoration of the destroyed housing stock, the reconstruction of damaged infrastructure and industrial buildings, and the resumption of work at all construction sites in the country will lead to a sharp increase in demand for concrete, which will obviously exceed existing production capacity. Therefore, one of the key priorities of Ukrainian concrete plants today should be the implementation of a strategy and relevant development projects aimed at increasing productivity without losing quality. Currently, the biggest drivers of demand for concrete are infrastructure construction, the construction of fortifications and various military defenses, as well as the reconstruction of war-affected regions. For obvious reasons, residential construction does not show clear markers of market stabilization. One of the peculiarities of concrete supply is the short logistics leverage and sensitivity to meeting the concrete mix delivery schedules [1].

The current conditions of concrete production pose a number of challenges related to the mobility of production facilities, delivery logistics and the economic feasibility of infrastructure solutions. Mobile and stationary-mobile concrete mixing units allow production to be adapted to geographical changes in demand, but require careful planning of location and use to avoid cost overruns and ensure product quality.

At the same time, remote construction sites require a balanced decision on the location of the units, taking into account logistics costs, delivery time, and project scope. In addition, the development of the concrete market, in particular the creation of large integrated companies, is increasing competition, stimulating the optimization of production and logistics processes.

Consequently, concrete plants are faced with the task of developing effective planning and management mechanisms that will ensure: optimal location of production units in accordance with demand and logistical constraints; coordinated delivery logistics to minimize costs and maintain product quality; flexible production management in the context of market changes and the needs of development projects.

In general, comprehensive planning and management allows not only to effectively solve current problems, but also to formulate a development strategy adapted to the requirements of the modern building materials market.

A key role in managing the flow processes in the ready-mixed concrete supply chain is played by optimization planning of ready-mixed concrete supplies and sales based on demand forecasting, the impact of pricing decisions/price placement by delivery region, plan-to-fact analysis, etc. The goal of optimization planning is to maximize the difference between total revenues and costs of production and distribution. The result is a system of interconnected plans. A generalized scheme of the planning process in the management of ready-mixed concrete production and logistics is shown in Fig.

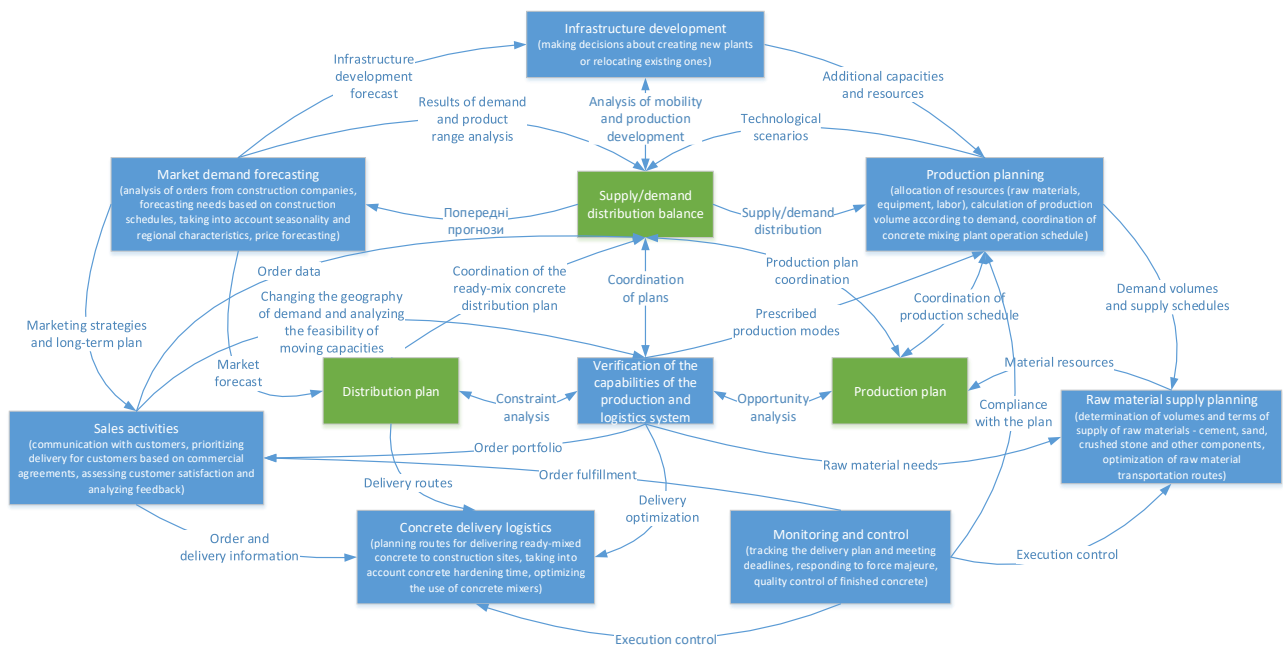


Fig. – Generalized scheme of the planning process for the production and logistics of ready-mixed concrete

Thus, a multi-level model for planning the production and logistics of concrete delivery has been developed, which allows solving the problem of coordinating supplies with the overall development plans of the enterprise.

In order to fully take into account all interdependencies, constraints, dynamics and uncertainties, a simulation model was created that covers all processes in the production and logistics of ready-mixed concrete. The simulation model was developed in the AnyLogic environment [2] and consists of components, each of which reflects a separate element of the dynamics of the enterprise's behavior and concrete distribution infrastructure.

The developed simulation model can be useful at the planning stage and allows for more accurate forecasting of the duration and modes of work during production operations at concrete plants and delivery of products to consumers, and thus is useful for influencing decision-making, forecasting the progress of work and better management of production and logistics processes, in order to increase productivity, reduce downtime and reduce costs.

The generated solutions can be a useful tool to help managers, dispatchers, and engineers of concrete plants plan their operations.

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IMPROVING INNOVATION ACTIVITIES BASED ON THE CREATION OF SOFTWARE PRODUCTS AS OBJECTS OF INTELLECTUAL PROPERTY OF AN IT-COMPANY

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Modern IT companies must demonstrate stability and flexibility in the market in the conditions of crisis phenomena, fluctuations in demand, the emergence of the latest gadgets and software, increased competition. Innovative management methods can ensure stability and sustainable development.

List of problems that IT companies most often face: problems with project management when scaling up, lack of definition and understanding of areas of responsibility of each employee, imperfect assessment of the team's workload, lack of knowledge of effective management among company managers, making management decisions without taking into account reliable and timely financial reporting, migration of talented IT specialists abroad [1], the lack of legal protection for a computer program as an object of intellectual property rights leads to the inability to create long-term competitive advantages.

The problems that IT companies face today can be solved by developing an IT strategy for innovation activities.

An IT strategy is a document that provides the company's management with an answer to the question of the possibilities of using information technologies for business development and the cost of the resources needed for this. That is, an IT strategy is a scenario according to which it is proposed to develop the enterprise's information systems. At the same time, an IT strategy highlights the degree of importance of information technologies for business development in general and its individual areas [2]. Taking into account the above, Fig. 1 formulates the stages of developing an IT strategy for improving the innovative activities of an IT company based on the creation of software products taking into account the legal aspect, that is, as objects of intellectual property.

So, we can formulate the following definition of an IT strategy for innovative activity: it is a technical assignment for a comprehensive project to improve the innovative activity of an IT business enterprise.

The development of an IT strategy depends on the type of organization of the IT company's activities.

Modern practice allows us to distinguish between IT outsourcing and IT product. IT outsourcing involves writing custom software, i.e. any services are created for a specific client. IT product is the development and creation of our own software [3].

Fig. presents a strategy specifically for IT companies of the product type. The IT strategy of innovative development includes, in addition to the creation of software products, also the organizational aspect of the IT sphere, related to the organization and

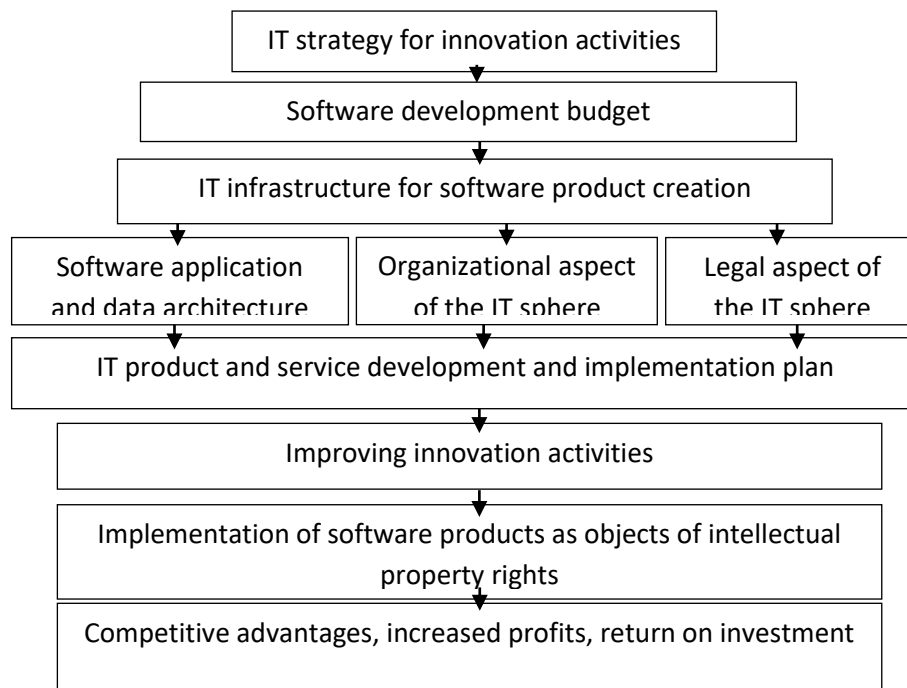


Fig. – IT strategy for improving the innovative activities of an IT company
(adapted and supplemented by the authors based on [1] – [3])

motivation of personnel, through constant improvement of the qualifications of employees, continuous training, the use of effective motivation methods, such as: modern remuneration systems, behavioral methods of stimulating IT specialists, as well as the legal aspect of the IT sphere through the protection of software products as objects of intellectual property rights.

Consequently, making management decisions on improving innovation activities is directly related to the capabilities of personnel, the latest IT technologies, and intellectual work. That is why a very important aspect of improving the efficiency of modern enterprises is intellectual property as the basis for socio-economic transformations and the development of innovation activities. Improvement of Ukrainian legislation in the field of intellectual property provides new opportunities for IT companies to obtain rights to software products, which creates long-term competitive advantages for the innovative development of both the enterprises themselves and the state as a whole.

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DEVELOPMENT OF INNOVATION-INVESTMENT POLICY FOR REGIONAL DEVELOPMENT PROJECTS

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This paper explores the strategic process of developing an innovation-investment policy tailored to drive regional development projects. In an era characterized by rapid technological advancements and globalization, regions worldwide seek to capitalize on their unique strengths and assets to foster innovation, entrepreneurship, and sustainable economic growth. Drawing upon a comprehensive review of literature, case studies, and policy frameworks, this paper outlines a systematic approach for crafting an effective innovation-investment policy that aligns with the specific needs and opportunities of a given region.

The paper begins by emphasizing the importance of conducting a thorough assessment of regional assets, including human capital, infrastructure, industry clusters, and research institutions. It underscores the significance of stakeholder engagement, encouraging collaboration among government agencies, businesses, educational institutions, and community organizations to garner diverse perspectives and foster collective ownership of the policy development process.

The research delineates key objectives and targets for the innovation-investment policy, emphasizing job creation, economic diversification, competitiveness enhancement, and quality of life improvement as primary goals. It discusses a range of policy instruments and tools, including financial incentives, regulatory reforms, capacity-building programs, and innovation ecosystem support mechanisms, tailored to address the specific needs of different industries and stakeholders.

In an increasingly interconnected and competitive global economy, regions across the world are recognizing the pivotal role of innovation in driving sustainable economic growth and prosperity. Innovation serves as a catalyst for productivity enhancements, job creation, and the emergence of new industries, thereby shaping the trajectory of regional development. Coupled with strategic investment, innovation can unlock latent potential and propel regions towards greater competitiveness and resilience in the face of evolving challenges.

Recognizing this imperative, policymakers, government officials, and regional stakeholders are increasingly turning their attention towards the development of innovation-investment policies tailored to their specific contexts and aspirations. These policies serve as strategic roadmaps, guiding the allocation of resources, the cultivation of ecosystems, and the creation of conducive environments for innovation-led growth.

This paper delves into the intricacies of crafting an effective innovation-investment policy for regional development, offering insights gleaned from a synthesis of academic literature, empirical studies, and best practices from around the globe. By dissecting the multifaceted dimensions of regional development and innovation ecosystems, this paper aims to provide a comprehensive framework that

policymakers can leverage to navigate the complexities of policy formulation and implementation.

The following sections will elucidate key steps in the development of an innovation-investment policy, beginning with the assessment of regional assets and needs. Subsequently, the paper will delve into the importance of stakeholder engagement, delineate policy objectives and targets, and elucidate a range of policy instruments and tools tailored to catalyze innovation and investment. Furthermore, the paper will underscore the significance of access to finance, skills development, talent retention, and sustainability considerations within the policy framework.

By offering actionable guidance and strategic insights, this paper endeavors to empower policymakers and regional stakeholders to chart a course towards inclusive, resilient, and innovation-driven regional development. In doing so, regions can unlock their full potential, harnessing the power of innovation and investment to foster prosperity, competitiveness, and sustainable growth for generations to come.

The development of an innovation-investment policy for regional development represents a critical endeavor in today's rapidly evolving economic landscape. This paper has underscored the importance of strategic policymaking tailored to harness the transformative potential of innovation and investment in driving sustainable growth, fostering competitiveness, and enhancing the overall well-being of communities within a region.

Through a systematic approach encompassing stakeholder engagement, asset assessment, policy formulation, and implementation, regions can cultivate vibrant innovation ecosystems that stimulate entrepreneurship, spur technological advancements, and propel economic diversification. By aligning policy objectives with the unique strengths, challenges, and aspirations of a given region, policymakers can catalyze the emergence of new industries, job opportunities, and pathways to prosperity.

The success of innovation-investment policies hinges on fostering collaboration, leveraging resources, and building synergies among government agencies, businesses, educational institutions, research organizations, and community groups. By fostering an inclusive ecosystem conducive to knowledge exchange, technology diffusion, and talent retention, regions can amplify their innovation potential and position themselves as hubs of creativity and entrepreneurship on the global stage.

The journey towards realizing the full potential of innovation-led regional development is not without its challenges. Policymakers must navigate complexities such as access to finance, skills mismatches, regulatory barriers, and sustainability considerations while maintaining agility and adaptability in the face of evolving dynamics.

In this context, ongoing monitoring, evaluation, and iteration of innovation-investment policies are essential to ensure their effectiveness, relevance, and impact over time. By embracing a culture of continuous learning and improvement, regions can refine their strategies, address emerging challenges, and seize new opportunities in an ever-changing economic landscape.

INFORMATION SYSTEMS CLOUD MIGRATION STRATEGIES CLASSIFICATION

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Cloud migration hereinafter refers to the process of moving applications, services, code, and business logic from on-premises deployment to the infrastructure of the selected cloud provider [1]. The migration strategy means the method and technical means of performing the cloud migration process [2].

There are several basic cloud migration strategies [2]:

- Lift and Shift strategy (or a direct migration).
- Refactoring strategy.
- Reengineering strategy.

A direct migration strategy has been extensively studied as a common initial approach for organizations migrating to the cloud. However, [2] notes that this approach can lead to poor performance and high costs if information system (IS) components are not optimized for cloud services. A feature of this strategy is the consideration of the architecture of the existing system as a black box. That is, the main focus is on the inputs and outputs of the existing system. The strategy may include switching to a cloud version of an already used DBMS, adding load balancing, adding an automatic increase/decrease in the number of instances of system components (does not work well in the case of a monolithic architecture) [3].

A refactoring strategy here refers to the process of making certain architectural adjustments to applications to be able to take advantage of cloud functions and services. The refactoring strategy pays more attention to the internal architecture of both the IS itself and its components, compared to the direct migration strategy, and therefore is more expensive to implement due to the need for a thorough analysis of the existing architecture, but the IS after migration is more adapted to the use of more services of the selected cloud platform.

The reengineering strategy is characterized by a complete redesign and restructuring of the application architecture to maximize the compatibility of IS components with the cloud infrastructure. Also, in the case of monolithic applications, it is advisable to adapt the microservice approach to the organization of the general IS architecture, which in the cloud environment provides the possibility of an individual approach to each IS component, and therefore the widest possible use of the capabilities of the selected cloud platform in relation to each individual IS component [4]. Although the implementation of this strategy requires significant effort and resources, it lays down the greatest potential for optimization and scalability. By rewriting applications using a native cloud architecture, organizations can take full advantage of cloud services and achieve maximum performance and flexibility.

Based on the characteristics of each migration strategy, it is proposed to form the following basic criteria for classifying the above-mentioned strategies:

- speed of implementation, which characterizes the amount of time required to perform migration according to the chosen strategy. Units of measure - t months, $t \in [1, +\infty)$
- the cost of implementation, which characterizes the amount of monetary resources required to carry out the migration by the chosen strategy, m US dollars, $m \in [1, +\infty)$
- target scalability of the system, which characterizes the degree of possibility of further integration of IS components with new cloud services (if necessary) under the current architecture without the need to completely rewrite the existing component code (or write from scratch). Acquires values in the interval. $[0,1]$

It should be noted that the task of determining the threshold values of the proposed criteria, as well as expanding the set of these criteria, are further tasks of scientific research.

Considering the above, the formation of classes of the above-mentioned strategies and the use of the proposed criteria for their classification will allow us to form the task of classifying migration strategies and simplify their selection for the appropriate IS component based on business requirements and existing architecture.

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RESILIENT BUSINESS PLANNING FOR COMPANIES IN UKRAINE

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The full-scale war in Ukraine has significantly changed how businesses operate, making it essential for companies to adopt flexible approaches to planning. Ukrainian businesses face unique challenges, such as broken supply chains, financial difficulties, workforce shortages, and unpredictable markets. These challenges show how important it is to use modern and innovative management tools and strategies. There is a critical need for management scholars to use the opportunity to research the effectiveness of management tools and strategies in ensuring business resilience in Ukraine. This paper focuses on the need for these approaches and organizes adaptive strategies using current management methods.

The war has imposed significant disruptions on companies in Ukraine. Logistical challenges caused by the destruction of critical infrastructure have made delivering goods and services increasingly difficult. Financial instability, including restricted access to credit and reduced consumer purchasing power, has further strained operational capacities. Mass displacement and military mobilization have also created acute labor shortages, disrupting the continuity of skilled workforces. The rapid shifts in demand patterns and overall market uncertainty have required businesses to adopt agile and flexible planning processes [1,2].

Adaptive approaches have emerged as essential components of business planning in wartime conditions in response to these challenges. Scenario-based planning has proven effective in enabling companies to anticipate various outcomes and prepare appropriate responses. By modeling potential disruptions, businesses can identify vulnerabilities and allocate resources efficiently to mitigate risks. For example, organizations leveraging financial modeling tools to simulate cash flow scenarios under different conditions have been better equipped to navigate financial uncertainties [3].

Another critical adaptation is the accelerated digital transformation of businesses. Companies have increasingly relied on digital platforms to sustain operations amidst physical disruptions. Tools such as customer relationship management (CRM) systems and e-commerce platforms have allowed businesses to maintain customer engagement and revenue streams despite challenging circumstances [4]. This transition to digital tools has not only ensured continuity but also provided a foundation for post-war recovery and growth.

Collaboration with stakeholders, including international donors and local governments, has also played a vital role in supporting business survival. Partnerships enable access to funding, knowledge sharing, and the development of innovative solutions. For instance, international programs such as those by the World Bank have established investment insurance mechanisms, providing critical financial support to companies in Ukraine [5]. This collaborative approach enhances resilience by pooling resources and expertise to address complex challenges collectively. Essential element of wartime business planning has been the emphasis on workforce resilience and

adaptability. Companies have increasingly invested in training programs to upskill employees and prepare them for dynamic roles within disrupted operational environments. Hybrid and remote work arrangements, combined with flexible scheduling, have allowed businesses to retain talent and ensure continuity even during heightened instability [2, 5]. These strategies underline the necessity of integrating human resource development into broader business planning efforts, further strengthening company resilience.

Leadership has emerged as a cornerstone of company resilience during wartime. Crisis leadership, characterized by rapid decision-making, effective communication, and a focus on employee well-being, has been instrumental in guiding businesses through uncertainty. Training programs aimed at enhancing managerial competencies in crisis conditions have shown significant promise in strengthening organizational stability and adaptability [6].

The systematic use of management tools has further enabled businesses to survive and adapt. Risk assessment frameworks, such as SWOT and PESTEL analyses, allow companies to identify priorities and develop targeted strategies. Business continuity planning (BCP) frameworks have also proven effective in maintaining critical operations during crises, ensuring that companies can respond proactively to disruptions [7].

Regional and sector-specific strategies have enhanced the adaptability of Ukrainian companies. SMEs, for instance, use resource pooling and cooperative marketing to tackle supply chain issues and cut costs. These efforts help maintain market presence despite logistical challenges. Innovations in agriculture and manufacturing further showcase localized solutions for wartime problems [8].

In conclusion, the war in Ukraine has highlighted the urgent need for adaptive approaches to business planning. By integrating scenario-based strategies, digital transformation, collaborative partnerships, and effective leadership, companies can navigate the profound challenges of wartime conditions. These adaptive measures ensure survival and establish a foundation for sustainable recovery and growth. Future research should continue to explore the effectiveness of these strategies, with particular attention to their scalability and long-term impact on company resilience.

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INTEGRATED APPROACH TO CHANGE MANAGEMENT

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Changes are an integral part of any business. In today's dynamic external environment, the set of Q external factors of influence is supplemented by the following: $Q_{\text{emergence}} \subset Q$, which play an aggressively negative key role, forcing market participants to operate in the mode of a man-made emergency (catastrophe) and under the legal regime of martial law. That describe the day-to-day operation, including such factors as globalization, technological progress, market dynamics, regulatory framework, etc., require regular adaptation (change) of the internal environment of the enterprise. The set of environmental factors that are the basis for changes can be represented by a couple. $Q = \{Q_{\text{emergence}}, Q_{\text{general}}\}$, whose strength and quantity are dynamic parameters.

According to organizational theory, change can be defined as the process of moving an organization from the current state S_t to the future state S_{t+1} , which includes changes in processes, systems, structures, policies or technologies. According to Kotter [1], change is seen as a means of transforming organizations to achieve desired results. Due to the multifaceted nature of change, it has a different impact on the organization at all levels from strategic changes to operational changes, each of which has its own implications for the organization.

Changes in the organization can be classified by source (*internal/external*), quality (*progressive/retrogressive*), duration (*short-term, long-term, random*), nature (*natural/technological/man-made*), predictability (*predictable/unpredictable*), dynamics (*gradual/radical*) and sphere of influence (*strategic/operational*).

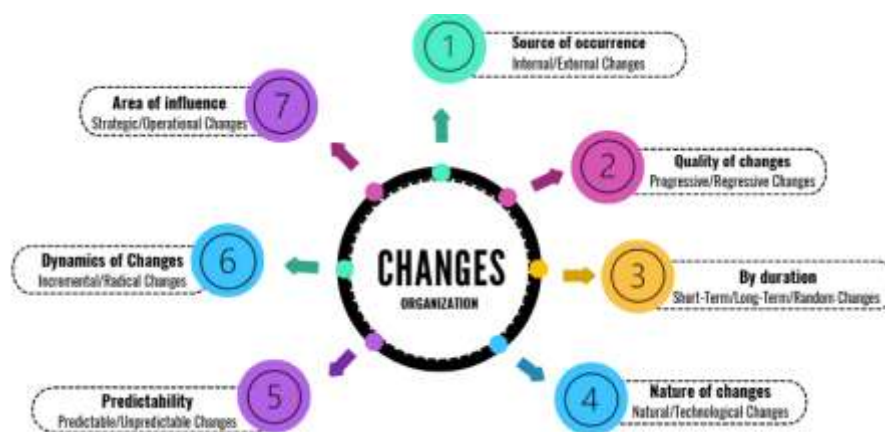


Fig. – Classification of changes

In this context, the issue of defining and measuring the concept of change management effectiveness arises.

Operating on a day-to-day basis, an organization uses transformation processes as a key mechanism for implementing strategic objectives aimed at adapting to market conditions and ensuring sustainable development [2].

Each state S_t is characterized by a set of indicators: economic $\{Ek_1, Ek_2, \dots, Ek_n\}$, environmental $\{E_1, E_2, \dots, E_m\}$, social $\{C_1, C_2, \dots, C_j\}$, etc. Being expressed quantitatively as a function of the resource capital R of the organization and considered in the dynamics, these indicators become criteria of the quality of its functioning.

An analysis of existing change management models (K. Levin, J. Kotter, ADKAR, etc. [3, 4]) identifies their important common feature, such as the cyclical nature of transformations. However, when the scale of consideration is increased on a time scale, the fundamental similarity of the ideology of change management and project management is revealed.

Thus, Kurt Levin's model suggests 3 stages of change process:

- 'unfreezing' (preparing the organization and staff for change by understanding its necessity and overcoming resistance)
- 'change' (implementation of new approaches and adaptation to new conditions in the process of overcoming difficulties)
- 'freezing' (consolidation of changes to ensure their sustainability) [5].

The analysis between the stages of Levin's model and the project approach showed their logical similarity.

The first stage corresponds to the project initiation and planning phase, when preparations for change are made, and conditions are created for their implementation.

The second one correlates with the project implementation phase, and 'freeze' stage can be compared to the final phase of the project and the recording of results. The updated state S_{t+1} , the characteristics of the organization's resource capital, can be interpreted as the project product.

At the same time, change management largely focuses on the human aspects, the human capital of the organization, without focusing on the purely technical aspects of ensuring change.

In parallel with this, the introduction of external factors of influence into the consideration of the $Q_{\text{emergence}}$ set necessitates the use of the concept and measure of enterprise sustainability, which should be considered in a harmonized manner, in a single ecosystem with the ideology of project adaptive management and active decision-making strategies.

In summary, the integration of these approaches ensures a balanced and successful implementation of changes in the organization.

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APPLICATION OF THE GENERAL LINEARIZATION ALGORITHM TO IMPROVE PROJECT MANAGEMENT

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In the rapidly developing world of nowadays, information technologies become a foundation for solving complicated problems in various branches of science and industry. The optimization is one of such important areas that enables finding the best solutions for attaining results desired while minimizing the expense or maximizing the efficiency.

Problems of linear fractional optimization appear in many real situations when it is required to optimize the ratio between multiple parameters. For instance, this can be a problem of minimizing the prime cost of a product subject to reserving a certain level of quality or maximizing the profit when resources are restricted. Such problems are often of a nonlinear origin, which complicates their solution aided by conventional linear programming methods. Therefore, one of important areas of research consists in linearization of such problems that enables using efficient linear optimization algorithms.

The linear fractional optimization in project management is one of the most efficient approaches for solving complicated problems associated with planning, distribution of resources and management of risks. This method enables optimizing the ratio between multiple important parameters of a project, such as value, time, execution quality and other indicators being of critical importance for successful project closeout.

The linear fractional optimization differs from conventional methods in the fact that the objective function in such problems is written as a fraction where the numerator and the denominator are linear functions. For instance, it can be a ratio of expense vs executed works quality or of the project fulfilment time vs the project quality. Problems of this type frequently appear in the real life, especially in the project management where it is essential to find the optimum ratio between various resources and results.

One of the most common examples of using the linear fractional optimization in project management is given by a problem of minimizing the expense per a unit of time or resource while maximizing the tasks completion quality. For example, in planning of a construction project, managers can use linear fractional models for optimizing the expense for construction materials and manpower with ensuring a high quality of works and good meeting of the schedule milestones at the same time.

Another example is given by resources usage optimization. In large-scale projects, such as construction of infrastructures or implementation of new technologies, it is required to efficiently distribute the resources across multiple project stages. Using the linear fractional optimization, we can minimize the expense per one unit of productivity or increase the productivity within a constricted budget, which is essential for a successful project closeout.

As it is difficult to solve linear fractional problems with the help of conventional optimization methods, they are frequently linearized, i.e. converted into

linear form. This is attained by introducing new variables that allow reducing the fractional function to a linear one, after which standard linear programming methods, such as simplex method, can be applied.

The linear fractional optimization is also used in risk management. In the project management, risks are often measured in the form of a ratio of a certain event probability vs its consequences. Linear fractional optimization can help to minimize potential expenses with maximizing the efficiency of risk management measures at the same time.

The advantages of linear fractional optimization include the possibility of taking account of complicated relationship between multiple project parameters, which enables obtaining more accurate and well-balanced solutions. It also provides flexibility in decision taking, as the managers can model various event development scenarios and select the most optimum way.

However, it is worth mentioning that the linear fractional optimization is the most complicated from the calculation point of view. It requires significant resources for solving and may require special algorithms and software. This creates a certain challenge for its utilization in real projects, especially in cases with a big number of variables and constraints.

The linear fractional optimization of a powerful tool in the area of project management, especially in optimization of complicated ratios between the expense, the time and the quality. It enables attaining significant results in project management ensuring efficient allocation of resources and minimization of risks. Regardless of the complicacy, this method possesses a big potential for further development and wide application in the practical project management.

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INFORMATION TECHNOLOGIES IN CONSTRUCTION PROJECT MANAGEMENT

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Digital transformation in the construction industry is a complex process of Building Information Modelling (BIM). The concept of BIM is currently undergoing active development, while the basic requirements and scope of work of all participants in the construction process are changing [1].

BIM FOR THE CUSTOMER

Project owners have long been resigned to the typical problems of construction projects, such as budget overruns and delays in the execution of work.

However, the current market situation is forcing them to reconsider their attitude to the project development and implementation process.

The owner of a future property can gain significant benefits from using information modelling tools and processes:

Reducing the financial risks of the project based on reliable data to estimate its value in the early stages of the project.

Evaluation of various indicators of the facility at the concept stage - analysis of volumetric planning solutions, functional analysis.

The ability to explore various scenarios, alternative project options, assess energy efficiency, future consumption of various types of resources during the operation phase.

Reducing the project release time through the use of parametric models, 3D coordination of its sections, structural analysis and virtual representation of the facility, 4D visual planning of the construction and construction processes, optimisation of logistics at the construction site, and quick response to unforeseen circumstances.

Managing project costs based on reliable information - models with databases of estimated standards, prices for components and equipment; generating estimates in parallel with project development.

Optimisation of building management and maintenance based on the use of the information model by the maintenance services [2].

VIM FOR THE CONTRACTOR

A construction contractor gets the maximum benefits when it is involved in the project at an early stage. However, even if the design is complete, practice shows that it makes sense to develop and use a construction BIM model to support a range of construction processes.

BIM provides the following benefits to construction contractors:

Structural analysis and conflict detection. BIM tools allow you to selectively check for conflicts between certain systems. These software tools can be used to analyse 'soft' conflicts, i.e. to find violations of tolerance requirements at the distance between systems.

Determining physical volumes and estimating project costs. BIM allows you to calculate the cost of a project based on an assessment of the parameters of various model components, labour costs, the cost of using machines and mechanisms, and the current cost of equipment.

Visual planning and control of construction. 4D modelling tools allow you to simulate the planned sequence of work on the preparation of the construction site and the construction of the facility. With their help, you can visually understand what the construction site will look like, as well as see the building under construction at any given time.

Comprehensive control over the construction process, budget execution and other management functions based on the use of the facility information model [2].

AND THE FACILITY IS READY FOR OPERATION.

Only 10-15% of the cost of a building is spent on design and construction, while up to 90% of the cost is spent on management and operation. BIM is becoming a powerful building management tool that provides a return on investment.

The main benefits of BIM integration for building owners and managers include

- the ability to use accurate and complete data stored in the building information model;

- the ability for facilities managers to interact with project participants at the early stages of work on the facility, which helps determine the types of data required during the operation and maintenance phase and decide how the facility will be maintained after commissioning;

- improving the efficiency of specialists involved in the operation and maintenance of the facility, gaining prompt access to quality information about the facility;

- availability of accurate and complete data for planning preventive maintenance activities that extend the life of the facility and its engineering systems;

- timely planning of repairs and logistics to minimise the risks of facility operation and maintenance;

- improved management of inventory, stocks and supplies of the necessary equipment and materials for ongoing repairs and maintenance [2].

The creation of a single construction project model based on a coordinated exchange of information between all participants makes it possible to use it with a high degree of trust.

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DEVELOPMENT OF AN INTEGRATED APPROACH TO THE IMPLEMENTATION OF IT PROJECT QUALITY MANAGEMENT

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Analysis of existing approaches and practices for project quality management in the field of information technology has shown that the implementation of this subject area is mainly reduced to identifying and ensuring the achievement of the quality of the initial product of an IT project, while the quality of the IT project management process disappears from the focus of attention of managers and the project team. From this we can conclude that the reason for not achieving the expected quality of the initial product of an IT project or increasing costs to achieve its required quality can be both poorly organized work on the project and project management processes, including the project quality management function.

The solution to this problem is the development of an integrated approach to the implementation of IT project quality management, in which an important place is given to planning and ensuring the quality of: the initial product of the IT project; works and built-in modules that make up the content of the IT project; IT project management processes (main and auxiliary) at all stages, taking into account the identified features of projects in the field of information technology.

The implementation of the project quality management function should begin at the early stages of planning to clarify the boundaries (framework) of the project. At this stage of planning, it is necessary to very carefully examine the customer's requirements for the quality of the project's output product, ensure that all quality characteristics of the output product are perceived identically by the customer and the project performer, correlate them with the work and organizational procedures of the project and build them into the appropriate processes and modules (blocks) of the project. This stage of the project life cycle is especially important for IT projects, therefore it is necessary to ensure that all customer quality requirements are correlated with the relevant work of the project and integrated into the appropriate modules of the IT project.

For IT projects, it is at this stage that it is necessary to take into account (implement) the first and partially the second of their features by developing and controlling procedures and regulations for communications with the customer to clarify the requirements for the quality of the project, developing and controlling the availability of procedures and regulations for detailing the compatibility of the project's IT product with the customer's operating system to clarify the requirements for the content and quality of the IT project product; developing and controlling procedures and regulations for detailing the customer's business processes to clarify the requirements for the content and quality of the IT project product; controlling the availability and implementation of procedures for analyzing the customer's information infrastructure to clarify the configuration of the designed IT system or module. And here it is advisable to introduce the following criterion for quality

control of the IT project management process - assessment of deviations in accordance with the results of the IT project and its goals.

At the stage of planning the content of the project, the quality assurance program development should take into account almost all the features of the IT project. It should be added to the above that, taking into account the features of the functional heterogeneity of the IT project in quality management processes, it is recommended to include in the quality assurance program the development of procedures for controlling the regulations for managing the integrated interaction of the execution teams, procedures for the coordinated use of limited project resources, and control of project configuration management procedures.

Taking into account the specifics of IT projects, which reflect the need to adjust tasks and work during the project implementation process and the possibility of a phased launch of the IT project product into the customer's operational activities, the quality assurance program within the framework of an integrated approach to IT project quality management, in our opinion, should include: control of procedures and regulations for managing newly identified customer needs during the project implementation process; procedures for monitoring the compliance of project processes with quality plans; procedures for monitoring the results of project stage completion; control of the availability and implementation of project change management procedures; control of project configuration management procedures; control of the availability and implementation of procedures for managing the adjustment of IT project framework parameters and goals.

In addition, the formation of an IT project quality assurance program in the context of an integrated approach involves: developing requirements for the quality management system, quality assurance parameters by type of work and project stages; developing quality assessment criteria; describing quality management procedures and determining quality assessment methods.

An important element of the IT project quality assurance program is the definition of the organizational structure of quality management, that is, assigning responsibility for implementing IT project quality management to individual specialists or a relevant specialized unit in the organization.

In the field of information technology, a quality management system must ensure the integration of methods and ways of organizing project implementers responsible for the design, development and maintenance of an IT product in order to meet the needs of customers and users while minimizing the resources spent.

In this regard, in the project quality assurance program, such subject areas in project management as project resource management play an important role, because the comprehensive assessment of the quality of the completed IT project depends on the quality of their implementation, which includes the quality of the project work performed, the quality of the project output product, and the quality of the innovative IT project management processes.

The evaluation indicators according to these criteria can be generally accepted indicators of planning quality, which record deviations from planned indicators and the number of adjustments to planned indicators of the corresponding planning horizon.

The conducted study of the features of IT projects showed that in the field of IT project quality management there are problems of a functional, methodological and organizational nature, which are related both to the features of IT projects and to the fact that project quality management focuses on ensuring the quality of the project's output product and the quality of project work, while not paying significant attention to the quality of the IT project management process.

The study proposes an integrated approach to IT project quality management, which includes planning and quality assurance processes:

- the initial product of the IT project;
- works and built-in modules that make up the content of the IT project;

management processes (main and auxiliary) of the IT project at all stages, taking into account the identified features of projects in the field of information technology.

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FEATURES OF BUSINESS PROCESS MANAGEMENT IN IT COMPANIES

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Characteristics of BPM in IT companies. In IT companies, Business Process Management (BPM) is characterized by the integration of Agile and Lean methodologies, extensive process automation through BPM software, and a strong emphasis on Continuous Integration and Continuous Delivery (CI/CD). Agile methodologies, such as Scrum and Kanban, facilitate iterative development and rapid response to changing requirements, enabling teams to deliver value more efficiently. Lean principles focus on eliminating waste and optimizing processes, enhancing overall productivity and quality. The adoption of Agile and Lean approaches allows IT organizations to remain flexible and responsive in dynamic environments[1].

The focus on CI/CD practices further distinguishes BPM in IT companies. CI/CD pipelines automate the integration and deployment of code changes, ensuring that software updates are delivered rapidly and reliably. This approach minimizes the risk of errors and reduces time-to-market for new features.

Challenges in business process management for IT companies. Managing cross-functional teams in IT companies poses significant challenges due to their distributed nature and diverse skill sets. Teams often operate across multiple time zones, making real-time collaboration difficult, particularly for tasks requiring synchronous input. Companies rely on advanced communication tools like Slack, Microsoft Teams, and Jira to address these issues, which facilitate asynchronous updates and streamline task management. However, these tools alone cannot resolve cultural and communication barriers that arise in distributed teams. Effective onboarding programs and standardized collaboration protocols are essential to ensure consistency in workflows and minimize miscommunication [2]. The rapid pace of technological evolution in IT exacerbates business process management challenges. New technologies, such as AI and blockchain, frequently require businesses to overhaul their workflows.

Balancing standardization and customization is a critical concern in IT business process management. Standardized frameworks, such as the Scaled Agile Framework (SAFe), provide a scalable approach to process consistency while accommodating organizational growth. However, client-specific solutions often require deviations from standardized practices, particularly in projects with unique industry requirements. Cloud-based BPM platforms like Appian and Bizagi address this issue by allowing for flexible process customization without sacrificing scalability[3]. Figure 1 illustrates how these interconnected challenges interact, highlighting the need for a strategic approach to managing business processes in IT companies. This interplay between team management, technological adaptation, and customization demands requires continuous optimization to align operational goals with dynamic industry standards.

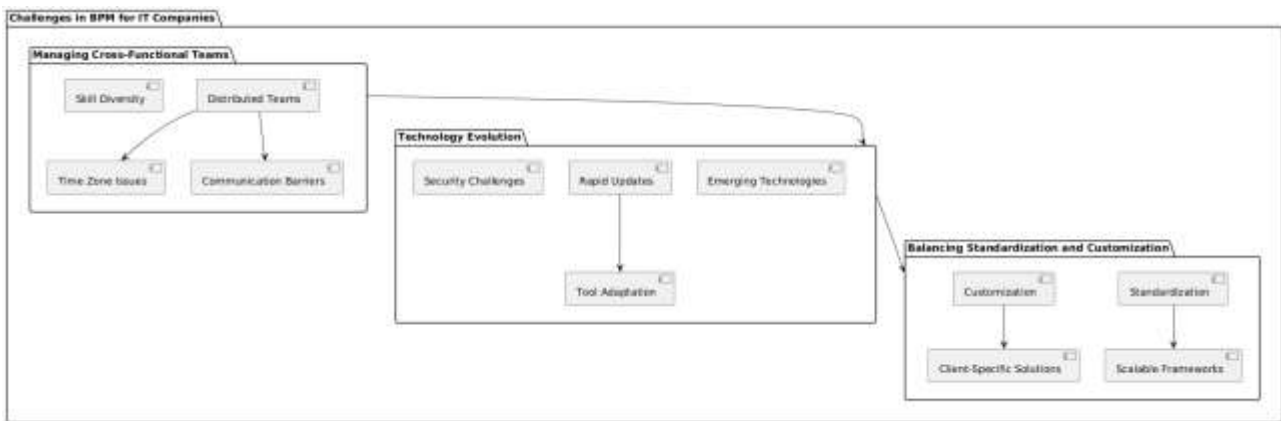


Fig. – Challenges in BPM for IT Companies. Source: created by the author

Optimization of business processes. DevOps practices are central to streamlining collaboration between development and operations teams, ensuring continuous integration and deployment (CI/CD) pipelines that minimize downtime and accelerate product delivery[4]. Data analytics and artificial intelligence (AI) play a pivotal role in process optimization, with platforms like Tableau and Power BI providing real-time insights into project progress and operational bottlenecks. AI technologies, such as machine learning models, are increasingly used to predict resource demands, automate routine tasks, and optimize scheduling, significantly reducing costs. Scalable frameworks, including SAFe and ITIL, are widely adopted to ensure seamless resource allocation and alignment of team efforts with strategic goals[3]. These tools and strategies are interconnected and drive a unified approach to achieving operational excellence while remaining adaptable to technological and market changes.

Conclusions. Optimization of business processes in IT companies relies on the integration of DevOps practices, data-driven decision-making, and scalable frameworks, supported by cutting-edge tools and cloud infrastructure, to enhance efficiency and adaptability.

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THE ROLE OF STRATEGIC MARKETING IN ENSURING EFFECTIVE PROJECT MANAGEMENT

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In the modern business environment, effective project management has become a critical factor for the success of any organization. One of the key elements that directly affects the success of projects is strategic marketing. Strategic marketing helps to define the right direction for projects, clearly formulate goals, and effectively implement strategies that meet market and consumer demands.

Strategic marketing is a set of actions aimed at achieving the long-term goals of a company through market analysis, strategy development, product or service positioning, and the implementation of marketing initiatives. It provides a company with competitive advantages by offering a clear understanding of consumer needs, competitor actions, and changes in the market environment. Project management involves implementing clearly defined tasks within certain resources and time frames. However, for these projects to be successful, it is crucial that they meet market requirements and satisfy the needs of end consumers. This is where strategic marketing comes into play, as it: helps to clearly define project goals; identifies the target audience and their needs; assesses the competitive environment and opportunities for innovation; ensures the project adapts to market changes and consumer trend preferences.

Let's consider the role of strategic marketing at different stages of project management.

Stage 1: Project Planning. At the planning stage, strategic marketing helps to: analyze the market, identify competitive advantages, and develop a positioning strategy. Conducting research helps identify existing problems, consumer needs, and gaps in the market that can be filled through the project. Understanding how a product or service can stand out from competitors allows the project to become more attractive to the target audience. This helps to clearly define how the product will be presented in the market, which is essential for the successful implementation of the project.

Stage 2: Project Implementation. At the implementation stage, strategic marketing ensures: coordinated interaction between teams and the adaptation of the project to consumer demands. Through marketing strategies, internal teams can be clearly focused on accomplishing tasks, considering changing market conditions. Using feedback from consumers and analytics helps adjust the project's strategy when necessary.

Stage 3: Evaluation and Adjustment. At the evaluation stage, strategic marketing ensures: monitoring the project's effectiveness and adjusting the strategy. By analyzing the project results (e.g., through marketing KPIs), it is possible to determine whether the desired outcomes have been achieved. If certain marketing activities did not yield the desired results, strategic marketing allows for quick adjustments.

One of the vivid examples of effective use of strategic marketing in project management is the launch of the new project management software product, Trello.

Market and Needs Analysis. Before launching Trello, the team at Atlassian (the developer of Trello) conducted thorough marketing research. They discovered that most existing project management tools were complex to use and required significant effort to master. Consumers needed a simple and visual tool that would allow them to easily organize tasks without unnecessary complexity.

Product Positioning. Meeting this need became the foundation for Trello's positioning. The idea was to create a user-friendly, flexible, and easy-to-use project management tool that could cater to any team, from startups to large corporations. Trello was positioned as a tool that does not require extensive training and offers an intuitive interface. This became its key competitive advantage in a market where other software products were more functional but considerably more complicated to use.

Target Audience and Marketing Strategies. The primary target audience for Trello consisted of small and medium-sized businesses, startups, and freelancers looking for a simple solution for project management. Additionally, Trello also attracted larger organizations due to its flexibility and ability to adapt to different types of workflows.

Trello's marketing strategy was built around the simplicity and accessibility of the tool, appealing to a wide range of users who sought an easy and effective way to manage projects.

The marketing strategy included the following elements.

Free plan: Trello offered free access to basic features, allowing companies and individual users to try the product without obligations and experience its benefits firsthand.

Viral marketing: The simple and accessible usage model led to users recommending Trello to their colleagues and friends.

Integration with other tools: Trello marketed itself through partnerships and integrations with other popular work tools, such as Google Drive, Slack, and Zapier, which further increased the product's ease of use.

From the very beginning of Trello's launch, marketing strategies were closely tied to the development and project management process. The team worked to create a simple, convenient, and flexible platform that would meet users' needs. They continuously collected feedback from users to quickly adapt the product to new requirements and improve its functionality. They also used marketing research data to create new content and promotions to attract new users.

Through strategic marketing, Trello was able to not only attract a large number of users but also build a sustainable competitive advantage in a market dominated by more complex and less user-friendly tools. As a result, the product became part of the Atlassian ecosystem, largely due to strong marketing efforts.

This example clearly demonstrates how strategic marketing can determine the success of a project in the information technology industry. The positioning of the product, focused on simplifying project management processes, along with the integration of marketing strategies into the development process, helped Trello become a leader in its niche. That's why it is crucial for strategic marketing to be integrated into all stages of project management to ensure maximum results and minimize risks.

TOWARDS THE PROCEDURE OF ARTIFICIAL INTELLIGENCE-BASED TOOLS SELECTION TO USE IN SOFTWARE DEVELOPMENT PROJECTS

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The integration of artificial intelligence (AI) into software development significantly increases the efficiency of tasks within the development life cycle (SDLC), in particular by automating code generation, reviewing, and predicting errors [1]. AI tools integrated into development environments (IDEs) help speed up software development processes, increase code quality, and improve developer interaction with systems [2]. The use of machine learning and natural language processing allows to improve requirements analysis and defect prediction, which increases the efficiency of technical tasks [3]. In addition, recommender systems and chatbots provide support for development processes, simplifying the tasks of project team members [4]. An important scientific and practical task is to create a model for the informed choice of AI tools, which will help increase the efficiency of software development projects.

The proposed mathematical model is a Boolean optimization problem that allows forming a set of AI tools to perform a set of tasks of a software development project, taking into account the aspects of quality (according to the Gartner Peer Insights methodology [5]) and cost.

The main goal of this study is to minimize the total cost of using AI tools while ensuring that minimum estimates of quality requirements are met.

The presented procedure for selecting AI tools for software development projects based on the principles of optimization (Fig. 1) begins with the formation of a set of project tasks $T = \{t_1, t_2, \dots, t_n\}$ representing various types of software development activities that require AI support.

Subsequently, the available AI tools are identified, forming a set $A = \{a_1, a_2, \dots, a_m\}$, which includes various solutions that can help at different stages of the software development lifecycle.

To evaluate the available AI-based tools, we compile scores based on information from sources such as Gartner Peer Insights. These values evaluate AI tools on many aspects, including pricing and customer experience, integration and deployment, service and support, and functionality capabilities. The costs associated with these tools are determined using open sources, which provides a comprehensive assessment of both qualitative and quantitative aspects of the use of AI tools in support of software development processes.

In addition, the introduced procedure (Fig.) involves determining the minimum acceptable scores for AI tools in terms of pricing and customer interaction, integration and deployment, service and support and functionality capabilities. The introduction of constraints will ensure that only those tools are selected that meet the defined thresholds for each of the quality aspects of the AI tool.

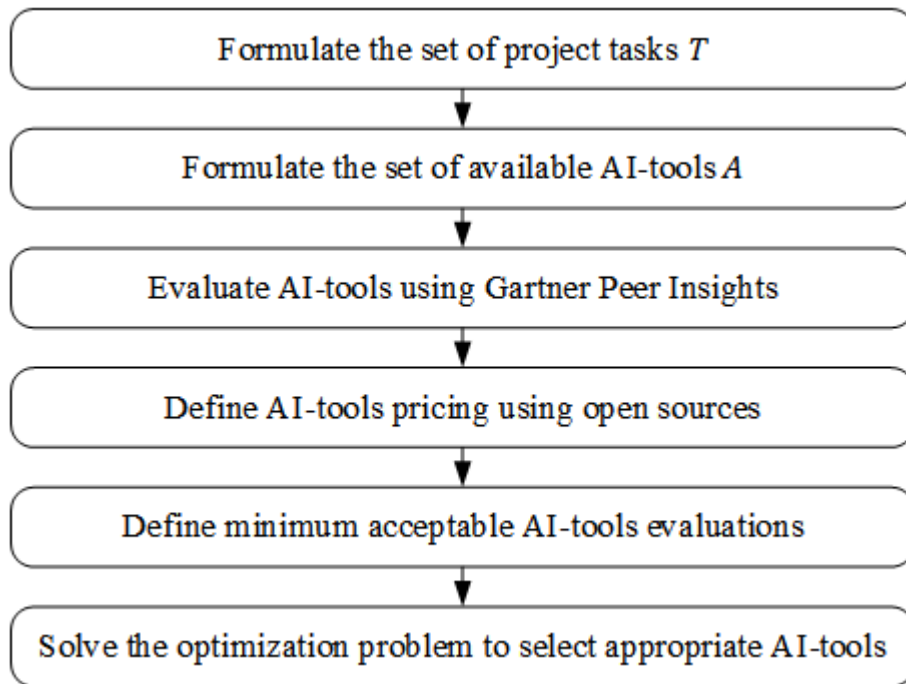


Fig. Generalized scheme for solving the problem of a reasonable choice of AI tools to support software development processes

The formulated optimization problem minimizes the total cost of the selected AI tools while satisfying constraints related to the minimum acceptable scores of AI tools, the restriction on selecting only one tool for each task of a software development project, and the constraints on Boolean optimization variables. The obtained solution will provide a reasonable choice of AI tools that will increase the efficiency of a software development project.

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STRATEGIC MANAGEMENT MODELS DURING THE IMPLEMENTATION OF PUBLIC-PRIVATE PARTNERSHIP PROJECTS

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In the context of transforming market relations in Ukraine, effective strategic management of public-private partnership (PPP) projects has become increasingly significant. This study aims to synthesize the theoretical and methodological principles of PPP organization and develop recommendations for establishing its state regulation mechanism.

Analysis of international experience reveals that the British PPP model, based on the PF2 standard, demonstrates optimal effectiveness. This model encompasses several key elements: enhanced partnership between public and private sectors, accelerated procurement processes with reduced costs, increased service provision flexibility, and ensured procedural transparency.

Strategic management of PPP processes in Ukraine is governed by fundamental legislation and necessitates a systematic approach to establishing long-term objectives and implementation mechanisms. The key regulatory framework comprises the Law of Ukraine «On Public-Private Partnership» [1] and the Cabinet of Ministers Resolution «On Approval of the Procedure for Analyzing the Effectiveness of Implementing Public-Private Partnership» [2]. These documents establish a strategic sequence of stages: strategic planning and proposal preparation, comprehensive effectiveness analysis, and strategic decision-making regarding project implementation.

A promising model for implementation in Ukraine is the «mixed life cycle contract» (LCC), which encompasses facility design, construction, and operational management throughout its lifecycle. The distinguishing characteristic of this model is that project payment occurs in equal installments post-commissioning, contingent upon the private partner maintaining the facility according to specified functional requirements.

An essential component of strategic management is the implementation of a PPP monitoring system, which incorporates performance indicator assessment, deviation analysis, and adjustment of contract parameters and project implementation schemes. This necessitates a comprehensive evaluation of projects' social, commercial, and budgetary effectiveness.

The strategic significance of PPP projects demonstrates extensive prospects for long-term economic development. Within the context of Ukraine's European integration strategy, these projects create new strategic opportunities for enterprises and enhance their competitive positions. A fundamental aspect of the strategic transformation of PPP relations is the paradigm shift in interaction, where the state transitions from direct control to assuming the role of a strategic private sector partner.

The National Institute for Strategic Studies emphasizes the importance of a strategic approach to PPP conceptualization, noting that public procurement, despite

public-private sector interaction, does not align with the strategic nature of partnership, as it is founded on tactical "customer-performer" relations. Expanding on this position, Pavlyuk defines strategic initiative in PPP as state-driven, engaging business in implementing socially significant strategic projects.

The current phase of PPP development is characterized by the formation of a comprehensive strategy for attracting private financing in priority economic sectors: construction, utilities, transport, healthcare, industry, tourism, recreation, and education. The strategic importance of such projects is determined by their alignment with long-term state policy objectives, establishing a foundation for identifying priority PPP areas in the context of activating investment and innovation activities and achieving strategic state development goals.

From a strategic management perspective, PPP should be considered a long-term process of resource consolidation, interest balancing, and achieving socio-economic compromise between public and private sectors [5]. A crucial aspect is the strategic planning of cooperation forms, encompassing various models from outsourcing to concessions and private financial initiatives.

The current state of strategic PPP project management in Ukraine is characterized by the absence of a comprehensive analytical model for assessing long-term effectiveness and risks [3]. Existing practices predominantly focus on financing sources rather than projects' strategic societal value [4]. This results in low implementation efficiency and necessitates the adoption of a strategic approach that prioritizes assessment of long-term social significance, followed by determining optimal implementation forms while considering fiscal risks [6].

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INTEGRATION OF eVTOL STRATEGIC MANAGEMENT INTO MODERN AIRSPACE

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Electric vertical take-off and landing aircraft (eVTOL) represent a significant step in urban air mobility. Their introduction aims to transform city transportation by providing fast, quiet, and eco-friendly solutions for passenger and cargo movement. Unlike traditional aircraft, eVTOL uses electric propulsion, which reduces emissions and noise. This technology also offers new opportunities to ease road congestion and enhance urban transport accessibility.

However, eVTOL implementation faces regulatory challenges. Existing aviation safety rules do not fully address eVTOL's unique needs, creating a demand for new standards in certification, maintenance, and safety. Pilot licensing, especially for autonomous systems, requires updated training aligned with eVTOL's specific operational needs, and strategies are needed to integrate eVTOL into urban airspace.

Technological advancements in eVTOL, from propulsion to automation, are not only innovations but also drive new regulatory standards, ensuring these aircraft operate safely in urban settings. Thus, eVTOL's success relies on combining tech innovation with regulatory adaptation.

Approaches to regulating eVTOL operations vary significantly between countries, reflecting different legal, economic, and technological realities. This includes implementing experimental certifications for eVTOL and designating restricted areas for test flights. At the same time, the FAA actively collaborates with private companies to develop solutions for integrating eVTOL into national airspace. One such initiative is the FAA's participation in the "Urban Air Mobility" (UAM) program, which aims to integrate eVTOL into urban environments. [1]

The European approach, coordinated by the European Union Aviation Safety Agency (EASA), focuses on developing specific requirements for eVTOL at the EU level. The European Union also emphasizes creating networks of urban air routes facilitated by the development of appropriate infrastructure for eVTOL operations. In addition, Europe places strong emphasis on environmental concerns, including requirements to reduce emissions and noise pollution. [2]

There are two key regulatory aspects:

1. Licensing. The issue of pilot licensing for eVTOL presents a significant challenge for regulators, as these vehicles differ from traditional airplanes and helicopters. In the United States, the FAA is developing new requirements for eVTOL pilots that combine airplane and helicopter operations skills, accounting for the unique nature of vertical take-offs and landings. Meanwhile, in Europe, EASA is working on a streamlined licensing system for eVTOL, emphasizing the importance of understanding autonomous systems and electric propulsion technologies. In China, the licensing process has also been simplified thanks to strong government support for the sector, encouraging the rapid adoption of eVTOL technologies. [3]

2. Maintenance. The maintenance of eVTOL aircraft differs from traditional aviation due to the use of electric motors and new battery technologies. In China, maintenance plays a crucial role in the rapid deployment of these vehicles, with the government supporting the development of new service centers dedicated to eVTOL. This ensures that the necessary infrastructure is in place to keep the aircraft operational and safe.[4]

Regulations greatly impact the development and deployment of eVTOL technologies, acting as both catalysts and obstacles. International bodies like EASA and the FAA support Urban Air Mobility (UAM) projects by launching experimental certification programs, allowing manufacturers to test and adapt new technologies more quickly for commercial use. Additionally, establishing standards for autonomous systems and battery technology fosters the creation of safe, reliable solutions.

However, current regulations can slow eVTOL integration into transport systems. The absence of unified standards for autonomous flights and varying certification processes across countries complicate market entry. The certification process remains lengthy and costly, challenging startups that must meet regulatory standards.

Regional regulatory differences further complicate global eVTOL development. The U.S. focuses on experimental flights and rapid testing, while Europe emphasizes environmental standards. This disparity underscores the need for harmonized international standards to ensure fair competition and simplify certification.

Regulatory bodies are gradually adapting frameworks to new realities, developing protocols to integrate eVTOL into urban infrastructure, including data exchange with traffic management systems. These efforts aim to accelerate the certification and adoption of new technologies in transport networks.

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FACTORS INFLUENCING THE QUALITY OF PROMPTS IN HUMAN-AI INTERACTION

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Prompts are one of the key elements of effective interaction between humans and artificial intelligence (AI). A **prompt** is an input query or instruction formulated by a user for an AI system to obtain the desired response. It defines the context, purpose, and format of the task, guiding the model to generate relevant results [1]. Acting as a 'translator' between human natural language and AI algorithmic processes, prompts allow for precise communication of intentions, avoidance of ambiguities, and control over the quality of output data.

Well-crafted prompts help obtain more accurate and relevant results, optimizing the process of information exchange between humans and AI. In the study [2], a large-scale investigation of prompt methods was conducted, aimed at systematizing and analyzing existing approaches to their development and application in various contexts. This research allowed for the creation of an initial prompt terminology, describing and structuring the main methods.

In this work, a cause-and-effect diagram of a prompt is constructed (see the figure below), identifying six key factors that influence its quality: input data, instructions, prompt methods, the human factor, technologies, and security. Below, each of these factors is discussed with specific examples of prompts demonstrating their impact on the outcome.

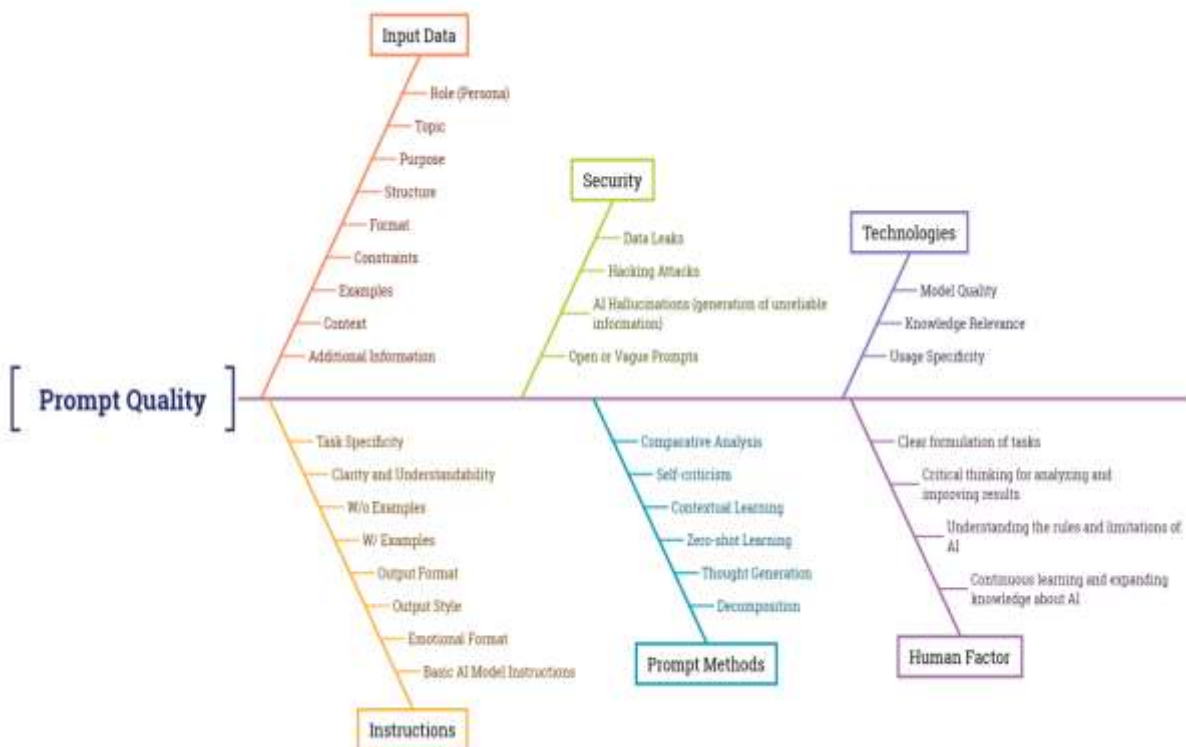


Fig. Cause-and-effect diagram of a prompt

Key Factors Influencing Prompt Quality

1. Input Data The quality of a prompt largely depends on the provided input data. Key aspects of input data include:

- **Role (Persona):** Defining a role helps improve the accuracy and formulation of the response. *Example prompt:* Without a role: "Write about marketing strategies." With a role: "Act as a digital marketing expert. Write about modern marketing strategies for small businesses." *Result:* The second prompt provides the AI with context for a more professional and focused response.

- **Topic:** Specifying the topic directs the AI to relevant content. *Example prompt:* Without a topic: "Tell me about technologies." With a topic: "Tell me about the use of artificial intelligence in medicine." *Result:* The second prompt narrows the scope of information, making the response more focused.

- **Purpose:** Clearly stating the purpose of the query increases the likelihood of obtaining the desired result. *Example prompt:* Without a purpose: "Write about Python." With a purpose: "Write a short beginner's guide on the basic functions of Python." *Result:* The second prompt clearly specifies the format and audience, making the response more structured.

- **Structure:** A logical and clear structure of the query allows the AI model to correctly understand the request. *Example prompt:* Without structure: "Tell me about the benefits of blogging." With structure: "List 5 main benefits of blogging for businesses and explain each of them." *Result:* The second prompt ensures a clear format for the response.

- **Format:** Depending on the task, the format can be textual, multimodal, code, etc. *Example prompt:* Textual: "Write an essay on the importance of education." Code: "Write a Python code to sort a list of numbers." *Result:* The format determines the type of response generated by the AI.

- **Constraints:** For example, word count, prohibition of certain words, or data format requirements. *Example prompt:* Without constraints: "Write about climate change." With constraints: "Write a short text (100 words) about climate change without using the term 'global warming'." *Result:* The second prompt limits the scope and content of the response.

- **Examples:** Providing examples increases the accuracy of the result. *Example prompt:* Without examples: "Write an advertisement for coffee." With an example: "Write an advertisement for coffee similar to this: 'Start your day with aromatic coffee that awakens your senses!'" *Result:* The second prompt provides a style sample, improving the response.

- **Context:** Relevant information, such as the current topic or previous conversations. *Example prompt:* Without context: "What is blockchain?" With context: "We were discussing cryptocurrencies. Explain what blockchain is and how it is related to Bitcoin." *Result:* The second prompt ensures a connection with previous information.

- **Additional Information:** Keywords, categories, etc., that help the model better understand the query. *Example prompt:* Without additional information: "Write about healthy eating." With additional information: "Write about healthy eating,

focusing on the benefits of vegetables and fruits." *Result*: The second prompt provides additional guidance for the response.

2. Instructions: Instructions play a key role in shaping prompts. Key aspects include:

- **Task Specificity:** Using specialized terminology to obtain more accurate results. *Example prompt*: Without specificity: "Write about finance." With specificity: "Write about the basics of financial planning for startups, using terms like 'budgeting', 'cash flow', and 'investments'." *Result*: The second prompt ensures a more professional response.

- **Clarity and Understandability:** The query should be precise and free of logical contradictions. *Example prompt*: Unclear: "Write something about technologies." Clear: "Write about the impact of artificial intelligence on manufacturing automation." *Result*: The second prompt ensures an accurate response.

- **Examples:** Providing examples helps the AI better orient itself in the task. *Example prompt*: Without examples: "Write about the benefits of veganism." With an example: "Write about the benefits of veganism, similar to this: 'Veganism helps reduce environmental impact and improves health.'" *Result*: The second prompt provides a style sample.

- **Output Format:** Defining the structure of the response (e.g., bullet points or text). *Example prompt*: Without format: "List the benefits of sports." With format: "List 5 benefits of sports in bullet points." *Result*: The second prompt ensures a clear structure for the response.

- **Output Style:** Choosing the tone (formal, informal) adapts the response to the user's needs. *Example prompt*: Formal: "Write a formal letter about product feedback." Informal: "Write a product review in a friendly style." *Result*: The second prompt ensures an appropriate tone.

- **Emotional Format:** Including emotional markers enhances the expressiveness of the text. *Example prompt*: Without emotions: "Write about a trip to Paris." With emotions: "Write an inspiring text about a trip to Paris, using words like 'charming', 'unforgettable', 'romantic'." *Result*: The second prompt makes the text more expressive.

- **Basic AI Model Instructions:** Using principles of instructing a specific model improves its adaptation to tasks. *Example prompt*: Basic: "Write about climate change." With instructions: "Using data from recent studies, write about the impact of climate change on agriculture." *Result*: The second prompt ensures a more in-depth response.

3. Security: Protecting confidential data and ethical aspects of interaction with AI is critically important. Key risks include:

- Data leaks.
- Hacking attacks.
- AI hallucinations (generation of unreliable information).
- Open or vague prompts that increase the likelihood of unwanted responses.

Example prompt: Dangerous: "Write a code to hack a system." Safe: "Write a code for network security testing while adhering to ethical standards." *Result*: The second prompt ensures compliance with ethical standards.

4. Prompt Methods: Various techniques significantly influence the effectiveness of prompts. Among the most commonly used methods are:

- Comparative analysis.
- Self-criticism.
- Contextual learning.
- Zero-shot learning.
- Thought generation.
- Decomposition.

Example prompt: Without a method: "Write about the benefits of electric cars."

With a method (decomposition): "Break down the topic 'benefits of electric cars' into subtopics: ecology, savings, technologies. Write about each of them."

Result: The second prompt ensures a more structured response.

5. Technologies: The capabilities of the AI model determine the effectiveness of prompts. Key aspects include:

- **Model Quality:** More powerful models generate better responses.

- **Knowledge Relevance:** The date of the last update of the AI's database affects the accuracy of results.

- **Usage Specificity:** Understanding the capabilities and limitations of a specific AI model.

Example prompt:

For a weak model: "Write about the basics of physics."

For a powerful model: "Write a detailed analysis of quantum mechanics with examples." *Result:* The second prompt leverages the capabilities of a powerful model.

6. Human Factor: The user is a key factor in the prompting process. Key aspects include:

- Clear formulation of tasks.
- Critical thinking for analyzing and improving results.
- Understanding the rules and limitations of AI.
- Continuous learning and expanding knowledge about AI.

Example prompt: Without critical thinking: "Write about the benefits of artificial intelligence." With critical thinking: "Write about the benefits and drawbacks of artificial intelligence, analyzing potential risks." *Result:* The second prompt ensures a more objective response.

Prompts are a powerful tool for optimizing interaction between humans and artificial intelligence systems. The effectiveness of prompts depends on six key factors: input data, instructions, prompt methods, technologies, security, and the human factor. Future research will focus on automating prompt creation and developing universal approaches for different types of AI models.

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EXPLORING THE IMPACT OF GENERATIVE AI ON INSURANCE DEVELOPMENT

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The insurance industry is currently navigating a pivotal moment, where the emergence of generative artificial intelligence (AI) presents both significant opportunities and complex challenges. As this transformative technology gains momentum, it holds the potential to reshape key aspects of the insurance landscape, including operations, customer interactions, and risk management. However, the path to implementing generative AI is not straightforward, as it introduces a range of interconnected issues that the industry must address [1].

This paper examines the crucial role that generative AI can play in the insurance sector by exploring several critical problems the industry is facing. One of the key challenges is the mismatch between insurers' efforts to enhance customer service experiences and the growing demand from customers for more personalized products that truly align with their unique needs and risk profiles. Additionally, many insurance companies are grappling with legacy technology, as outdated IT systems and infrastructure complicate the integration of new AI capabilities, impeding both innovation and operational efficiency. Data silos further exacerbate the issue, limiting the ability to fully leverage the vast amounts of data within the industry. Insurers also face mounting competitive pressure to quickly adopt generative AI in order to stay ahead of rivals, which contrasts with the traditionally cautious approach the industry has taken toward new technology. Furthermore, concerns around trust and ethics, particularly regarding privacy, data security, and the reliability of AI-generated advice, pose significant barriers to widespread adoption. Finally, insurers must navigate the complexities of restructuring their operational models to best capitalize on generative AI, balancing centralized governance with the need for decentralized innovation.

Next, we will examine potential solutions that aim to address the identified challenges and support insurers in effectively implementing and leveraging generative AI within their operations.

Customer-Product Mismatch

The disconnect between customer needs and insurance products can be addressed through generative AI and machine learning models that align products with individual requirements. By applying Natural Language Processing (NLP) and sentiment analysis to customer feedback, such as reviews on platforms like Yelp, insurers can identify areas for improvement and better match products to customer expectations. Predictive models, like logistic regression, can forecast customer preferences and behavior, enhancing product relevance [2]. Recommender systems and customer segmentation techniques can further personalize product offerings, ensuring they align with customer needs and preferences. These AI methods enhance customer-product matching, improving satisfaction and operational efficiency.

Legacy Technology and Complexity

Generative AI can help modernize legacy code and automate IT and development tasks, reducing complexity. Adopting a hybrid approach across IT and

the enterprise can gradually address outdated IT systems. Additionally, open-source AI solutions can improve interoperability and support containerization, streamlining operations.

Data Silos and Underutilization

To overcome data silos, deploying federated data frameworks can ensure meaningful customer data is accessible across the insurance sector. Facilitating data access from both core and non-core systems enables local generative AI model development. Additionally, integrating AI models that connect marketing, agency, claims, and underwriting databases can enhance their effectiveness and relevance.

Competitive Pressure and Innovation Speed

Empowering business units to make AI-driven decisions allows for quicker responses to changing market conditions and customer needs. Supporting innovation at the point of AI usage, rather than imposing a single model across all needs, fosters greater agility and relevance. For example, claims departments can use AI for faster fraud detection, while underwriting teams can leverage AI to offer competitive pricing. Research shows that decentralized AI models lead to a 2% improvement in the run/build ratio, 14% faster time to market, 9% higher customer satisfaction, and 5% boost in customer retention. This suggests that empowering business units not only accelerates innovation but also improves business outcomes, allowing insurers to stay competitive and responsive to market demands [1].

Trust and Ethical Concerns:

Governance of model performance should prioritize fairness, transparency, and the mitigation of inaccuracies. Ensuring that all models provide explainable results and clear confidence levels in decisions is crucial. Additionally, heightened focus on security, AI data stewardship, and privacy at the framework level is essential to maintain trust.

Operational Model Challenges:

Developing AI governance frameworks that ensure model ethics, regulatory compliance, and performance is essential across all AI models. An AI deployment model that empowers business units, with support from IT and data science, can enable cross-functional precision. Additionally, investing in training programs will help employees effectively work with generative AI.

In conclusion, the insurance industry is at a crucial juncture where strategically deploying Generative AI can tackle current challenges and promote business expansion. By addressing these interconnected challenges, insurers can stimulate innovation, enhance customer experiences, and gain a competitive advantage. Nonetheless, successful integration of AI necessitates overcoming technological, organizational, and customer-related hurdles, coupled with meticulous planning and robust AI governance.

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DEVELOPMENT OF AN INTELLIGENT RECOMMENDATION SYSTEM OF TELEGRAM CHANNELS FOR UNIVERSITY ADVERTISING STRATEGY

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In the modern digital world, social media has become an integral part of marketing strategies in various industries, including education. Many higher education institutions use different social networks to attract freshmen, raise awareness of their academic programs, and build their brand image [1]. Recently, the popularity of the social platform Telegram has been especially high among young people. As noted by researcher Khudoliy [2], the Telegram platform is actively used for communication, receiving news, and searching for information by 100% of Ukrainian first-year students and 88.9% of young people aged 17 to 19. The most recent study by the International Republican Institute in 2024 also confirms that Telegram is the most popular platform among Ukrainian youth, with 86% of respondents aged 16-35 using it daily or several times a day [3]. These data emphasize the growing role of Telegram as a tool for engaging young audiences, making it an irreplaceable tool for communicating with potential students and promoting educational services.

The large number of prospective advertising platforms with different topics, audiences, and costs creates significant difficulties when choosing channels for placing advertisements, even for experienced marketers. Accordingly, it requires a lot of money and time from universities and other educational institutions. These problems arise due to the lack of automated solutions that could, at a minimum, help organizations with marketing implementation and, at a maximum, completely reduce marketing costs while achieving the desired result.

The work is aimed at developing an intelligent recommendation system that is able to automate the analysis of Telegram channels and provide recommendations on choosing the most optimal ones for advertising university admission campaigns. The goal is implemented by the development of a multi-module application that will include downloading data from the Telegram API, its preliminary processing, analysis, and interpretation of the results. It has been proven that the Python programming language is one of the best tools for analysing social networks due to its libraries for data processing and visualization [4], which is why the work is based on the use of Python and libraries such as pandas and telethon, which allows access to up-to-date information about channels and efficient processing.

To perform the analysis of the data received, a ranking system has been developed that uses different statistical criteria for evaluating channels, such as audience size, level of activity, and content relevance. According to research [5], proper targeting is an important element of successful marketing strategies. It is important not only to distribute content in mass, but also to target a specific audience whose interests are aligned with the campaign goal. On Telegram, this can be

achieved by carefully selecting channels that meet the needs of the audience. Thus, channels targeted at applicants, their parents or teachers will be much more profitable for the admission campaign than just popular but irrelevant ones. That is why an additional criterion for content relevance was developed, which is calculated using LLM, since this type of model is currently able to programmatically analyse the content of a particular channel [6] and draw conclusions about its target audience.

The combination of statistical and content relevance criteria using the ranking method is the basis for developing a recommendation algorithm that allows creating an advertising strategy for an organisation. The use of modern technologies such as LLM, Python and relevant libraries will significantly simplify the software implementation and create an advanced application.

The intelligent system is being created primarily for technical universities, in particular, the system will be beneficial for use at the National Technical University «Kharkiv Polytechnic Institute» to help the university better plan its advertising campaigns by reducing the need for manual search and comparison of the channels.

To summarise, the proposed intelligent recommendation system of Telegram channels will be able to provide universities with more accurate and relevant recommendations for their admission advertising campaigns, thereby reducing costs and increasing the reach of the target audience. As a result of the work, it is expected to increase the efficiency of universities' marketing campaigns, which will contribute to their competitiveness in the context of growing competition in the educational services market.

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SELECTION APPROACH OF THIRD-PARTY LIBRARY USING RADIAL CHARTS AND TOPSIS METHOD

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A preliminary study identified the challenge of selecting a third-party library from multiple alternatives as a multi-criteria decision-making problem and substantiated its classification within this domain. To address this challenge, a model and method were developed to identify the most optimal alternative among third-party libraries. The evaluation in the study focused exclusively on technical metrics; however, the approach is flexible and can be extended to incorporate other types of metrics, such as human or economic aspects, for a more comprehensive analysis.

We have considered three key factors that influence the selection of a third-party library, each encompassing its own set of metrics. These factors include the project environment (green-field or brown-field) where the library will be integrated, the library's functionality, and its overall quality. To streamline the evaluation process, we used a scale from 0 to 10 for assessing each library's metrics.

Then, we proposed method that emphasizes a structured, two-step process that leverages crisp numerical data. These steps are designed to function independently while offering complementary insights when combined. Their straightforward and intuitive nature makes them particularly suitable for initial evaluations and comparative analyses of potential alternatives.

The first step, the visual selection step, employs radial diagrams, which serve as an efficient and user-friendly tool for visualizing and interpreting decision-making criteria (see Table 1).

Table 1 – Brief summary of the visual selection step

	<p>Advantage</p> <p>Enables a swift and intuitive identification of the most valuable, critical, or influential metrics in the decision-making process, facilitating faster evaluations.</p> <p>Disadvantage</p> <p>Restricts the number of metrics displayed on the diagram to preserve clarity and focus, which may limit the comprehensiveness of the analysis.</p>
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Figure 1 – Sample of a library affiliation to the field project (green- or brown-) constructed using the median of evaluations

Building on the use of radial diagrams, the second step – algorithmic selection step – employs a part of TOPSIS method (see Table 2). This method ranks alternatives i , where $i = \overline{1, m}$, based on normalized weighted scores v_{ij} for metrics j , where $j = \overline{1, n}$. It identifies the alternatives i that are closest to the ideal solution. The set J represents the metrics targeted for maximization. The significance of each metric j is incorporated through weights w_j , satisfying $w_j = \overline{0, 1}$, $\sum_{j=1}^n w_j = 1$. This approach requires pre-consolidated evaluations x_{ij} of the metrics for all alternatives as input, ensuring a systematic and quantitative foundation for decision-making. Finally, we should select the option with C_i^* closest to 1.

Table 2 – Brief summary of the algorithmic selection step

$v_{ij} = w_j \times \frac{x_{ij}}{\sqrt{\sum_i x_{ij}^2}}, \quad (1)$ $S_i^+ = \sqrt{\sum_j (\{\max_i(v_{ij}) \text{ if } j \in J\} - v_{ij})^2}, \quad (2)$ $S_i^- = \sqrt{\sum_j (\{\min_i(v_{ij}) \text{ if } j \in J\} - v_{ij})^2}, \quad (3)$ $C_i^* = \frac{S_i^-}{S_i^- + S_i^+}, \quad 0 < C_i^* < 1. \quad (4)$	<p>Advantage</p> <p>Simplifies the evaluation of involving trade-offs, such as balancing cost against quality or speed against accuracy.</p> <p>Disadvantage</p> <p>The outcome can vary significantly based on how weights are assigned, requiring careful judgment or expert consultation to avoid biased results.</p>
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Last but not least, it is important to note that our approach focuses exclusively on the metrics maximization, as this aligns with a scale from 0 to 10 applied across all metrics during the evaluation process. Using a sample of technical metrics that characterize a library's alignment with the project environment (green-field or brown-field), lower values closer to 0 typically indicate a brown-field project. Brown-field projects are generally considered a negative factor when replacing a third-party library, as they often carry a higher risk of adverse impacts on the project.

The results obtained using the TOPSIS method can also serve as a validation mechanism for subsequent approaches and methods based on alternative principles, such as fuzzy numbers.

The study emphasizes the potential for further improving the accuracy and reliability of the analysis by addressing the inherent uncertainty and subjectivity in decision-making processes when selecting third-party development tools in IT projects.

DEVELOPMENT AND EVALUATION OF THE EFFICIENCY OF A VIDEO INTERVIEW SYSTEM FOR ASYNCHRONOUS RECRUITMENT

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Asynchronous video interview systems are effective tools for optimizing recruitment processes, particularly in the context of widespread remote work. They allow recruiters to assess candidates without requiring simultaneous participation in interviews, significantly reducing time costs and administrative burdens. However, the lack of proper automation and adaptation of these systems to the specific needs of companies poses challenges for their implementation.

Objective. The development of a video interview system for asynchronous recruitment that ensures process automation, simplifies interaction between recruiters and candidates, and reduces time and financial costs.

Main part. The proposed system consists of several key modules, including video response recording and storage, candidate assessment, and integration with other HRM systems. It implements features for creating user profiles, conducting customized interviews, and generating automated reports.

A module for analyzing non-verbal signals is integrated to enhance the objectivity of candidate evaluation. The use of the *OpenCV* library allows real-time video processing, including facial expression analysis to identify primary emotional states (joy, surprise, neutrality, etc.). For this purpose, the *Haar Cascade Classifier* model is used to detect faces, and *Dlib* is utilized for recognizing key facial landmarks.

To analyze behavioral characteristics such as confidence or speech tonality, the system integrates solutions based on *PyTorch* and *TensorFlow* frameworks. Neural network models were trained on open datasets such as *FER-2013* (for emotions) and *RAVDESS* (for speech tonality). The architecture includes convolutional neural networks (CNNs) for visual data analysis and recurrent neural networks (RNNs) for processing audio streams.

Testing the module on 100 video interviews demonstrated an emotion recognition accuracy of 88% and a tonal analysis accuracy of 85%. This significantly improved the quality of candidate evaluation and reduced the impact of human bias on the selection process.

Conclusion. The proposed video interview system demonstrates high efficiency and is a promising tool for automating recruitment processes. Its further development includes integrating artificial intelligence modules for more accurate emotion analysis and expanding its functionality for use in other areas, such as education.

TOWARDS AUTOMATICALLY DERIVE DMN DECISION MODELS BY INTEGRATING LLM AND RAG

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Decision Model and Notation (DMN) is a decision modeling standard developed by the Object Management Group (OMG) [1]. It provides a standardized framework for modeling and automating business decisions and is widely used in industries such as finance, healthcare, and logistics. The Decision Requirement Diagram (DRD) is used to represent the requirements of decisions and the dependencies between the various constructs in the decision model. Decision Tables specify the underlying decision logic. DMN aims to provide a clear and simple representation of decisions in a declarative form and assumes the invoking context, which is responsible for ensuring correct invocation and execution of the decision, as well as data processing and storage and propagation of data and decision results throughout the process. This makes the DMN independent of the applications and the invoking context, and allows it to take advantage of the maintainability, scalability, and flexibility benefits inherent in service orientation for both modeling and decision mining.

Manually compiling decision tables and converting decision rules from natural language format to decision tables is a time-consuming and complex process. It requires technical expertise and creates barriers for non-specialists. Advances in Natural Language Processing (NLP) technologies such as Large Language Models (LLM) offer new ways to address this challenge by translating natural language into structured DMN outputs. LLMs like GPT-4 have already proven superior performance for a variety of other NLP tasks. By integrating LLMs with Retrieval-Augmented Generation (RAG), it is possible to increase the accuracy and contextual reliability of generated tables. This approach simplifies DMN modeling, enabling broader participation while maintaining consistency and scalability.

Automating the creation of DMN tables from natural language business rules remains challenging. Translating rules into DMN-compliant formats requires domain expertise and technical skills, creating barriers for non-specialists. Errors, such as incomplete or overlapping rules, undermine decision reliability, particularly in regulated domains like finance and healthcare [2]. Current approaches, including NLP pipelines and decision tree models, simplify the process for business users [3]. NLP techniques extract decision logic from text, while decision trees automate the conversion of predefined logic into DMN formats. These tools improve efficiency, but primarily support specialists, leaving non-specialists without direct access to DMN generation. Scalability and adaptability also remain key concerns. Rapidly changing business rules require systems that can dynamically adapt without manual intervention. Despite advances, existing solutions often lack the flexibility and accessibility required for broader adoption [4].

Integrating LLMs, such as GPT-4, with RAG provides a powerful approach to automating the generation of DMN tables from natural language business rules. LLMs excel at parsing and structuring decision logic, transforming statements such as "If a customer is over 30 and has an income over \$50,000, approve the loan" into structured, DMN-compliant output. Schema awareness is a critical component of this approach, ensuring that decision rules are aligned with predefined entity structures, attributes, and nested data. This alignment minimizes errors and ensures compliance with DMN standards. In addition, RAG provides an extra layer of accuracy by leveraging domain-specific knowledge to validate and refine the generated decision logic, ensuring rule consistency, completeness, and exclusivity [5]. The result is fully structured DMN tables in XML format, ready for direct use in decision systems. By reducing the dependency on technical expertise and providing intuitive interfaces, this approach empowers non-specialist users to engage in decision modeling while maintaining reliability and scalability. Such a solution significantly improves the accessibility and efficiency of DMN table generation.

Key challenges in automating DMN table generation remain unresolved. Effective schema preparation and dynamic adaptation to evolving business needs are critical to generating accurate decision logic. Validation processes require robust, automated methods to ensure rule consistency, completeness, and compliance. Improving usability through intuitive tools is essential to make the system accessible to non-specialists. In addition, scalability requires systems that can seamlessly integrate updates to business rules and domain knowledge without disruption. Addressing these issues will refine DMN automation and ensure its scalability, adaptability, and broader applicability.

By combining LLMs with RAG, it becomes possible to translate natural language rules into structured DMN outputs with improved accuracy and contextual relevance. This approach addresses key challenges such as reducing complexity, ensuring consistency, and enabling broader participation in decision modeling. However, open questions remain regarding schema preparation, validation mechanisms, and adaptability to evolving business needs.

The integration of LLMs and RAG lays a strong foundation for further research, paving the way for scalable, reliable, and user-friendly DMN automation across diverse industries.

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JUSTIFICATION FOR BUILDING A RECOMMENDATION SYSTEM FOR THE FORMATION OF IT PRODUCT STRATEGIES

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The IT market is changing rapidly in today's environment. A strong product strategy allows the company to quickly respond to changes and increase its competitiveness without deviating from its strategic development trajectory. An IT product strategy covers a system of processes that evolve and change along with the external and internal environment of the company. An IT product strategy is a well-defined action plan aimed at creating and developing a software solution that meets market requirements and business needs. Wrong planning, uncoordinated priorities, inability to adapt to the changing needs of customers (software users) can lead to the exit of the product from the market. An effective product strategy integrates various aspects of software product development, including IT market research (or a specific market segment), design, engineering, marketing, and sales. Typically, the strategy development process includes defining key goals, developing a roadmap, prioritizing, and assessing risks [1]. Many tasks are solved, which requires a lot of different information and processing of a large amount of data, at each stage of this process. Let's consider these problems.

Step 1. Definition of goals. The vision and mission of the product, its business goal, and the client's business values that will be implemented in the product are clearly defined. It is necessary to align the product goals with the business goals of the IT company, to understand the product goals not only by the product manager, but also by the entire development team.

Step 2. Development of a roadmap. The path to achieving the defined IT product goals is determined when developing a roadmap. It should include the main development aspects, deadlines, and the expected results. It is necessary to take into account the possibility of flexible adjustment of this map depending on changing circumstances (response to market changes, changes in the competitive environment, changes in customer needs and values, etc.).

Step 3. Priorities and evaluation of resources. Priority tasks are identified, and the necessary resources are assessed at this stage. An IT product development budget is formed, and budgets for marketing support of the product over time are developed. It is necessary to identify and review the competencies of all specialists involved in the process of product development and support, as well as other resources that are necessary to perform priority tasks.

Step 4. Risk assessment. Analysis and assessment of potential risks associated with the development, implementation, use and support of an IT product are carried out. Different types of risks, including market risks, are considered.

Step 5. Monitoring and optimization. Developing, implementing, and maintaining an IT product are a continuous process that requires constant monitoring and optimization. It is necessary to determine the success indicators of the IT product, i.e. key performance indicators (KPIs) that meet the defined goals. You need to constantly monitor their dynamics for effective product support. For example, you

need to constantly analyze user reviews and follow new trends in the industry. This will allow you to quickly adapt the product to changing conditions and identify opportunities for product improvement.

Step 6. Feedback and communication. It is important to maintain constant communication between all members of the development team, as well as with customers and end users throughout the process of developing, implementing, and maintaining an IT product. This will help balance the stakeholders' expectations with real results, identify problems in a timely manner, and find effective solutions to support and improve the product throughout product life cycle.

Therefore, flexibility and adaptability are key components of a successful IT product strategy. This will allow maintaining product competitiveness and meeting user needs. The main role in defining the product strategy is played by the product manager of the IT company. Important tasks of the product manager are to ensure that the development team provides not only a minimum viable product at the first stages of product life cycle, but also further tries to create the most viable product that meets the changing customers' needs and the business goals of the IT company.

It is proposed to develop the recommendation system to support the product manager's work. The main purpose of the recommendation system is to analyze various information about the customer's needs (existing and potential IT product users), identify certain patterns of their preferences, form recommendations for improving the values of the product's KPI, which is the basis for the formation of effective product strategies in the long term. Existing recommendation systems solve the information overflow problem by separating useful pieces of data from a huge amount of data provided by the user, for example, data on customer preferences, etc. A recommendation system can provide predictions about future changes based on the identification of certain patterns. Studies prove that the use of a recommendation system improves the quality and speed of managerial decision-making [2].

Modern recommendation systems use machine learning algorithms to provide suggestions based on the processing of large amounts of data [2]. They reduce the time to find important data and patterns that are necessary to form product strategies. It is proposed to use hybrid approaches using machine learning methods to develop a recommendation system for strategic management of IT products [2]. This will allow the IT company to personalize the customer experience with its products, identify and balance the business needs of users by implementing the appropriate functionality of the IT product.

The implementation and use of the proposed recommendation system will enable the product manager to form effective product strategies, the implementation of which will increase the company's sales in the highly competitive IT market.

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ANALYSIS OF IT-COMPANY CUSTOMER SEGMENTATION ISSUES BASED ON CLUSTERING METHODS

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Customer clustering of an IT company is an important problem in marketing and customer relationship management. The market customer is classified based on general characteristics in traditional marketing, such as statistical information about customers, lifestyle features and needs for an IT company's software product, or the characteristics of companies' activities as a client of an IT company. But this is not enough in today's ever-growing competition in the IT market. Customer clustering is a powerful marketing analysis tool that can provide valuable insights into customer behavior and preferences.

However, customer clustering is an analytical tool, and it has problems and limitations. Let's consider the main issues that can affect the effectiveness of customer clustering.

1. Data quality and availability. The quality and availability of data is one of the main challenges of clustering IT company customers. Accurate and comprehensive data is essential for effective clustering. Usually, there are incomplete or contradictory data, the use of which can lead to inaccurate definition of clusters. For example, if a customer's purchase history is incomplete, outdated, or data for certain customers or for some versions of an IT product is missing, then it may affect the accuracy of clustering results.

2. Choosing the right features for clustering. Choosing the right features is critical to determining differentiation between customer segments. However, it can be difficult to determine which features will provide an adequate division of customers into segments. For example, the use of such general features as income, marital status, profession, and similar features makes clustering questionable for buyers who use IT product for private purposes. The customer clustering method based on product information is proposed using a genetic algorithm in the paper [2]. Genetic algorithms are used to determine the centers of clusters. Therefore, the choice of features for clustering should be carried out for two types of users of IT products when segmenting customers of an IT company: 1) entrepreneurs (companies, holdings, etc.); 2) individuals (students, households, etc.).

3. Choosing the Right Clustering Algorithm. There are different clustering algorithms, each with its own strengths and weaknesses. Different algorithms may be more suitable for different data types or clustering purposes. For example, the k-means clustering algorithm is widely used, but it may not be ideal for datasets with complex or nonlinear data relations.

For example, the clustering-based approach to customer segmentation, which combines the K-means method with RFE (Recency, Frequency, Monetary) modeling, was discussed in the article [3]. This approach is simple and intuitive, allowing you to segment customers so that customers with similar behavior and usage habits are grouped together, then information is obtained that helps to understand the usage patterns of a product or service. So, determining the most appropriate algorithm for a

particular clustering problem requires expertise and a deep understanding of data and objectives.

4. Determining the optimal number of clusters. Although clustering algorithms group customers based on similarity, the number of clusters must be determined in advance (the maximum number of clusters). Choosing too few clusters can oversimplify customer segmentation, while choosing too many clusters can lead to duplication or redundant segments. However, there is no ideal method for determining the optimal number of clusters, as it depends largely on the specific data set and business context.

5. Interpretability of clusters. Clusters are often represented by numerical values, it makes difficult to understand the underlying meaning of each segment. For example, a cluster may be defined by features combination that are difficult to interpret or that have no obvious practical implications. It can hinder the usefulness of clustering results and make it difficult for companies to effectively use them. Visualizations and data exploration techniques can help reduce this issue by providing a more intuitive view of clusters.

6. Scalability. Not all clustering algorithms can efficiently handle large data sets. An IT company should consider the necessary computing resources and choose algorithms that can handle different amounts of data. In addition, it can become more difficult to interpret and apply clustering results with larger datasets. For example, when an IT company expands its dealer network across multiple versions of IT products, certain difficulties arise in collecting, analyzing and interpreting the increased volumes of data.

7. Dynamic customer behavior. Customer behavior is not static, and it can change over time. Segments can evolve over time, merging or splitting due to changes in customer behavior or market dynamics. Clustering analysis provides information based on historical data, but it may not capture changes in customer preferences or behavior in real-time. Consequently, the company needs to regularly update clustering models and adapt its marketing strategies to accommodate these changes.

In conclusion, while customer clustering analysis has its challenges and limitations, it remains a powerful tool for discovering new marketing opportunities for an IT company. By understanding potential obstacles and taking steps to mitigate them, IT companies can take advantage of customer clustering to improve their product strategies and drive business growth.

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MODERN TECHNOLOGIES AND MANAGEMENT OF AIR_OXIGEN MIXTURE FORMATION IN CPAP DEVICES

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Modern medicine faces unprecedented challenges, in particular, in the field of treatment of diseases of the respiratory system, which are among the most common causes of hospitalization and death in the world. In this context, innovative approaches to lung ventilation are becoming critical for improving patients' quality of life. One of the most effective solutions is the use of CPAP (Continuous Positive Airway Pressure) devices, which maintain constant positive airway pressure. These devices are indispensable for treating obstructive sleep apnoea syndrome and supporting respiratory function in cases of cardiopulmonary failure or other acute conditions.

The operation of CPAP devices is based on the principle of the formation of a stable flow of air-oxygen mixture, which is delivered to the patient. Proper adjustment of the composition of this mixture is extremely essential to ensure the effectiveness of the therapy, prevention of complications and optimal use of resources. Thanks to the rapid development of medical technologies, modern solutions not only enhance the precision of settings but also enable process automation, integration into the overall healthcare facility management system, and remote patient monitoring.

This publication addresses a highly relevant topic, encompassing a wide range of issues from the technical aspects of CPAP device operation to their integration into the digital infrastructure of hospitals and the training of medical personnel for effective use of these innovations.

A CPAP device creates positive airway pressure, preventing airway collapse during inhalation. The primary operational element involves delivering an air-oxygen mixture, which is formed by blending atmospheric air with medical oxygen in specified proportions. The mixture parameters are adjusted either manually or automatically, depending on the clinical case.

The main components of CPAP are the compressor that creates the airflow; oxygen dosing system for the formation of a mixture; filters for air purification; pressure and flow sensors for monitoring the operation of the device.

To form the air-oxygen mixture, proportional gas mixers are employed, which provide automatic oxygen dosing. This allows for highly precise oxygen concentration (F_{iO_2}) in the air-oxygen mixture and enables automatic parameter adjustments. Manual adjustment of the oxygen-to-air ratio is used in emergency situations or with portable devices, requiring a high level of expertise from medical personnel and careful monitoring of the patient's condition.

Intelligent dosing systems based on artificial intelligence (AI) algorithms are increasingly used today, offering adaptation to the patient's needs based on their condition. Artificial intelligence algorithms process large amounts of data, including medical history, previous ventilation parameters, blood oxygen level (SpO_2),

respiratory rate, and other physiological indicators. Based on this data, the system creates a model that predicts how the patient's body may respond to various ventilation parameters. Sensors of the CPAP machine collect data on the patient's condition in real time, such as the level of blood oxygen saturation, airway pressure, respiratory rate, and the degree of airway openness. Artificial intelligence processes these indicators, analyses trends and determines the need to adjust parameters. The algorithm can automatically adjust the pressure in the airways to prevent them from closing (apnoea), the ratio of oxygen and air in the mixture to ensure the optimal level of oxygen saturation, the rate of air supply depending on the patient's activity level, allowing to avoid undesirable conditions such as hypoxia (lack of oxygen) or hyperoxia (excess oxygen). Artificial intelligence is able to detect patterns that indicate approaching critical conditions, for example, sudden deterioration of respiratory function or sleep apnoea. Based on these forecasts, the device can warn medical personnel in advance or independently activate the necessary operating mode. IoT technologies allow remote control of CPAP machines using web interfaces or mobile applications used to monitor and adjust parameters. Cloud services can send notifications about technical malfunctions, reduced performance or the need for device maintenance. Patients using CPAP at home can be monitored remotely by doctors, which is especially important for patients with chronic conditions.

Hospital Management Systems (HMS) automate key processes for real-time monitoring of CPAP device operations, including the storage of operational parameters (pressure, flow, oxygen concentration) and their transmission to a unified hospital database. This functionality enables medical staff to respond promptly to changes in patient conditions. The systems also ensure the automatic recording of CPAP usage data for each patient, facilitate therapy efficiency analytics to identify optimal treatment protocols, and optimize device utilization. The integration of CPAP devices into hospital management involves the implementation of technologies that enhance the efficiency of CPAP usage, synchronize them with the overall healthcare facility infrastructure, reduce patient service time, ensure personalized treatment, and promote effective resource utilization. This integration improves the quality of medical services, reduces costs, and creates a comfortable environment for both patients and medical staff. Modern technologies in CPAP devices provide high treatment efficacy for patients with respiratory disorders and open new opportunities for innovation in healthcare.

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BASIC STRATEGIES OF ADAPTIVE MANAGEMENT OF THE PROFESSIONAL TRAINING SYSTEM OF EMPLOYEES

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The competitiveness of the enterprise depends on the speed of its reaction to changes in the external and internal environment. Adaptation takes place in all structural divisions of the enterprise, in particular, in the system of professional training of employees (PSTE). The level of adaptation of PSTE depends on the quality of formation and implementation of adaptive management strategies.

The works of the following scientists are devoted to research in the field of adaptive enterprise management: T. Borova, H. Yelnikova, M. Kyzim, K. Kryvobok, G. Nazarova, G. Polyakova, V. Ponomarenko, O. Raevneva, A. Chornyi, V. Yachmenyova and others. The relevance of the research topic is due to the need to form basic strategies for the adaptive management of PSTE at the enterprise.

The purpose of this work is to substantiate the strategies of adaptive management of PSTE at the enterprise based on the determination of the level of adaptation and the degree of adaptability of this system. The tasks that were solved to achieve the set goal: the expediency of assessing the level of adaptation and the degree of adaptability of the PSTE was substantiated; strategies of adaptive management of the PSTE are proposed: increasing the internal property of the PSTE, i.e. adaptability; the application of additional adaptation mechanisms related to PSTE.

PSTE is a complex system made up of many elements and interconnected with other subsystems of the enterprise. V. Yachmenyova [1] notes that adaptability is an internal property of the system, which can be hidden and difficult to measure. This potential property is directly related to the level of adaptation of the PSTE to changes in the internal and external environments [2].

The analysis of the scientific works of leading scientists and the study of the state of professional training in Ukraine as a whole and separately at industrial enterprises in the city of Kharkiv allows us to conclude that the following factors influence the PSTE at the enterprise: external (scientific and technical progress, the labor market, the legislative framework and the state training in the field); internal (mission and strategic plans; organizational structure and functional responsibilities of employees; competence of employees; qualifications of employees; state of training at the enterprise; loyalty and experience of employees). In accordance with the identified factors, the author developed criteria for assessing the level of adaptation of the PSTE to individual impacts. The importance of each factor and criterion was determined by an expert survey. As a result of building the factor-criterion model, there is a general value of the level of adaptation of PSTE as a whole, as well as adaptation to the influence of each of the factors separately.

A. Chornyi [3] notes that all factors considered in financial and economic analysis can be divided into two groups: financial and non-financial (socio-economic), material and intangible (intangible). Adaptability, both tangible and intangible, can be one of these factors. To determine it, modeling with structural equations is recommended, as it helps assess the influence of latent factors. The

model's purpose is to quantify how adaptability affects income levels. It allows for calculating the portion of income attributed to the adaptability of PSTE, with a higher portion indicating greater adaptability.

A comparison of the results of assessing the level of adaptation of the PSTE and the results of determining the degree of manifestation of its internal property – adaptability, allows to substantiate their direct relationship, to form reserves for increasing the level of adaptation of the PSTE, to single out two main strategies of adaptive management of the PSTE: aimed at increasing the internal property of PSTE - adaptability; aimed at the application of mechanisms of adaptation related to PSTE.

The first strategy is based on the use of self-learning, mentoring, coaching, budding, rotation, action learning and trainings to improve communication skills and team interaction, which can contribute to increasing the level of adaptation according to most factors of both the external and internal environment. These measures make it possible to create conditions at the enterprise for building a self-learning organization, the result of which is the continuous development and training of employees, which is accompanied by a significant acceleration of the updating of organizational knowledge, the acquisition of key competencies, and the formation of sustainable competitive advantages. The application of the indicated learning technologies helps to increase the degree of adaptability of PSTE.

The second strategy is based on the following measures to increase the level of adaptation of PSTE: acceleration of the response of the professional training system of employees to changes in the external environment, formation and implementation of effective management decisions in relation to these changes; increasing employee loyalty, reducing turnover, implementing an employee incentive system taking into account the achievement of training and development goals; balancing the amount of training with the costs of training at the enterprise.

The scientific novelty of the obtained results lies in the substantiation of two basic strategies of adaptive management of the PSTE: aimed at increasing the internal property of the PSTE, that is, its adaptability; targeted application of additional adaptation mechanisms in accordance with the effects of individual factors. Further scientific research will be aimed at substantiating tools for implementing basic strategies of adaptive management of the PSTE.

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APPLICATION OF AI IN PROJECT RISK MANAGEMENT: NEW HORIZONS

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In today’s dynamic markets and project environments, risk management has become one of the critical components of successful project management. Traditional risk assessment and management methods often fail to account for the dynamics of modern business and may be limited by human errors and subjectivity. Artificial Intelligence (AI) offers new opportunities for forecasting, evaluating, and managing risks, providing greater accuracy and adaptability in this process [1, 2].

One of the key aspects of implementing AI in risk management is its ability to predict potential risks in the early stages of a project. Using machine learning (ML), AI can analyze large volumes of historical project data and uncover hidden patterns and trends that may indicate potential threats. Predictive algorithms enable real-time analysis of current project conditions, identifying anomalies or deviations that may signal risks [3, 4]. For instance, studies show that using AI for risk forecasting in construction projects can reduce unexpected delays by 30% [5]. This approach is also suitable for IT projects, where risks may involve requirement deviations, market changes, or technical issues [6].

AI also enables the automation of risk management processes, including assessment and monitoring. Using cognitive algorithms, AI can continuously evaluate risks, automatically updating information on the project’s status based on new data. This approach significantly reduces the time required for information processing and allows for more rapid responses to changes [7]. AI also facilitates optimizing resource allocation in a project based on risk probability assessments, reducing costs and minimizing losses from risky events [8].

Integrating AI into risk management models, such as the “Three Lines of Defense” (3LoD) model (Fig.), improves the organization’s overall resilience to risks. This model integrates AI into three lines: operational control, risk management, and independent audit [9]. For example, the first line of defense—operational control—utilizes AI to automate operational monitoring and identify potential problems early. The second line—risk management—uses AI to analyze and evaluate threats, while the third line—-independent audit—applies AI to assess risk management effectiveness objectively [10.1].

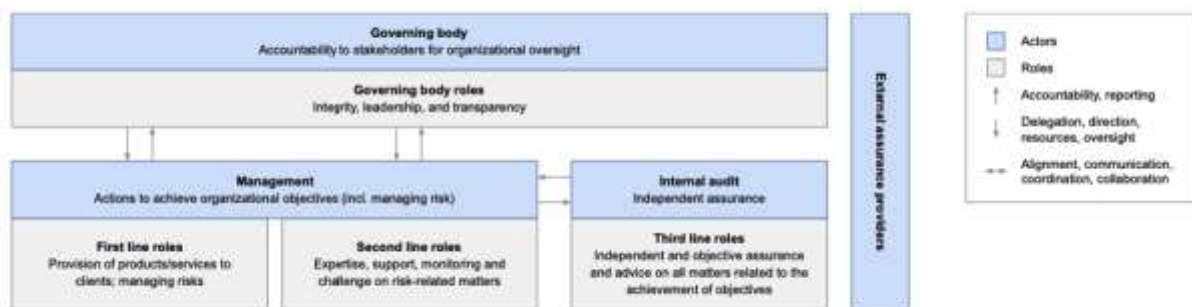


Fig. – Diagram description of the 3LoD model [10.2]

AI significantly enhances risk management efficiency by improving forecast accuracy and automating routine tasks. Applying AI in projects reduces risk management costs by 15-20%, accelerating decision-making through real-time data processing [3, 6]. Additionally, AI helps mitigate human factor impacts, reducing the likelihood of errors arising from subjectivity or insufficient information. Consequently, it ensures a more flexible and adaptive approach to project management, particularly under uncertainty [4, 8].

The further development of AI in project management will focus on advancing predictive algorithms and integrating new technologies for risk management. Implementing innovative solutions, such as Deep Learning and large language models (LLMs), will allow for even more accurate risk predictions and the development of effective prevention strategies [7, 10]. Specifically, combining AI with big data and cloud technologies will create more integrated systems for risk management capable of adapting to changing market and project conditions.

AI offers new opportunities for managing project risks by enhancing forecasting accuracy and automating management processes. This reduces costs, decreases the probability of errors, and improves project resilience to uncertainty. Further research should aim to enhance AI algorithms for risk management and expand their application across various industries.

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PROBLEMS OF LOCALIZATION AND NAVIGATION OF UAVS IN COMPLEX CONDITIONS

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Currently, unmanned aerial vehicles (UAVs) are used in nearly all fields. Their use in military operations has greatly contributed to their widespread adoption but has also revealed numerous operational challenges. These include limited flight range, GPS signal interference from tall structures and natural objects, the adversary's use of electronic warfare (EW) measures, the absence of satellite navigation systems (GNSS) in some areas, and the blocking, spoofing, or unavailability of GPS. Such risks are common in both military and civilian contexts.

In the military sphere, adversary disruption of GPS operations through active jamming or signal spoofing is one of the primary countermeasures against UAVs. Missions involving First Person View (FPV) drones typically require one operator to use multiple UAVs to effectively achieve mission objectives due to the risk of individual drone loss. The optimal composition for such missions is considered to be small groups of 3–5 drones per operator. These operations are often conducted in low-visibility conditions, such as at night or during adverse weather, where the use of visual landmarks is impossible. Additionally, deploying stationary support infrastructure for localization in combat zones is often unfeasible.

In the civilian sphere, for example, firefighting drones that rapidly detect and localize new fire outbreaks in natural environments must effectively and economically cover large areas. In these cases, visibility is often reduced by smoke, low lighting, or adverse weather conditions, making landmark detection unreliable. As in military scenarios, the use of stationary localization infrastructure is impractical due to the need for rapid deployment and high mobility.

One approach to solve the localization problem is the use of heterogeneous UAV groups where a lead drone, equipped with advanced navigation capabilities or operated in FPV mode, acts as a leader and serves as a reference for simpler, non-autonomous follower drones.

The system is based on the “leader-follower” dynamic interaction model. The lead drone, equipped with modern sensors and navigation systems such as visual-inertial systems or operator control, acts as a reference point for the group. Follower drones, equipped with basic onboard systems (cameras and flight controllers), use the trajectory and position data from the leader for cooperative localization and navigation. The system functions as a coordinated network, where follower drones maintain relative positions to the leader, ensuring stable formation movement. Implementing such a system provides:

- Economic efficiency by eliminating the need to equip each drone with expensive sensors;
- Adaptation to conditions without GNSS and limited visibility;
- Reliable inter-drone communication to maintain cooperative behavior in dynamic environments.

Various methods and approaches can be applied to implement this concept:

- Perspective-n-Point (PnP) with triangulation;
- OpenVINS (Open-source Visual-Inertial Navigation System);
- Distributed Fixed-Time Velocity Observer;
- Visual Place Recognition [2];
- Visual-Inertial Odometry (VIO) [1];
- VI-SLAM (Visual-Inertial Simultaneous Localization and Mapping).

Thus, several methods address the localization problem for UAV groups, but their practical implementation is complex and requires additional research and approaches, making this task both relevant and timely.

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TOWARDS THE IMPROVEMENT OF THE UNIVERSITY'S POSITION IN INTERNATIONAL RANKINGS BASED ON SYSTEM OF RECOMMENDATIONS OF RESOURCE ALLOCATION

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In the context of globalization and increasing competition among higher education institutions (HEIs), universities face challenges in the efficient management of resources. The use of key performance indicators (KPIs) has become an important management mechanism for HEIs. The main challenge is achieving the planned KPI targets. KPIs are used to evaluate universities in international rankings, such as QS World University Rankings (QS) and Times Higher Education (THE) [1]. The QS World University Rankings are among the most influential globally, and their constantly evolving methodology significantly impacts the position of HEIs in the rankings.

An analysis of global indices and rankings regarding the level and quality of higher education in Ukraine shows that while several Ukrainian universities are represented in leading global rankings, they do not occupy higher positions. Researchers and practitioners in higher education focus on analyzing KPIs as a tool for assessing HEI performance and enhancing the ranking of Ukrainian education. To successfully improve the ranking positions of Ukrainian HEIs, it is necessary to focus on key aspects such as academic reputation, scientific research, international activities, and others. An analysis of scientific works helps identify the strengths and weaknesses of HEIs according to QS criteria and demonstrates how HEIs can use this data to improve their positions and increase competitiveness.

To achieve high positions in international rankings, HEIs need to invest in specific areas of their activities. Since HEIs operate under resource constraints, including financial limitations, they face the challenge of effectively allocating resources to achieve planned KPI values, which are considered in international rankings. However, investing in HEI activities is a multifaceted problem requiring consideration of both current priorities and long-term goals.

Therefore, a recommendation system is proposed to help HEI management make informed decisions regarding resource allocation aimed at improving the university's ranking positions. This system will use tools for the optimal distribution of financial, human, and material resources, taking into account KPI priorities and budget constraints. Implementing such a system will contribute to achieving balanced results, considering the need for compromises between short-term needs and long-term goals. This is especially relevant in the context of limited HEI resources.

The recommendation system will be developed based on a hybrid approach, including the Knowledge-Based Recommendations method to incorporate expert knowledge about the significance of indicators and the Content-Based Filtering method to analyze historical data of HEIs [2-3]. Knowledge-Based Recommendations will use information about the specific characteristics of HEIs, their strategies, and the importance of each KPI. Based on conducted research, it was

found that for HEIs with a strong academic reputation, investments in scientific research may be more effective. For HEIs with lower internationalization indicators, directing funds toward attracting international students is more appropriate. Such recommendations are created based on identified patterns of KPI impact on HEI rankings. Thus, the research justifies the feasibility of using the Knowledge-Based Recommendations method to solve the problem of determining optimal investment directions, considering the strategic priorities of the institution.

Using the Content-Based Filtering method, the historical data of the university, including the results of investments in HEI activities and the achievement of planned KPI values, are analyzed. As a result of this method, HEI management receives personalized recommendations based on comparing planned and achieved values for each indicator. For example, if it is found that increasing funding for the teaching staff has contributed to improving the student-to-teacher ratio, the system may recommend increasing investments in this area. Additionally, to determine optimal HEI development strategies, the similarity of KPI values with those of other HEIs holding higher ranking positions is analyzed.

To allocate resources among HEI activity areas for increasing KPI values, it is proposed to use multi-criteria optimization. To solve the multi-criteria optimization problem, a genetic algorithm and machine learning methods will be used. This will allow for budget constraints to be considered and offer effective options for resource allocation. As a result, scenarios will be modeled that take into account possible risks of chosen decisions and identify the KPIs that have the most significant impact on HEI rankings. It is proposed to develop predictive models within the recommendation system to evaluate the long-term consequences of the resulting HEI resource allocation scenarios. For example, the system might suggest reducing investments in HEI publication activities in favor of infrastructure projects if it is determined that this can contribute to an increase in the KPI for international activities.

Thus, the proposed recommendation system is a strategic tool for managing HEI resources. Integrating this system into the strategic management framework of HEIs and its application will promote the efficient use of HEI resources to achieve planned KPI values. This, in turn, will contribute to improving the HEI's ranking and its competitiveness on the international stage.

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THE 5C GOAL-SETTING MODEL IN MARITIME INDUSTRY DEVELOPMENT PROJECTS

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Maritime industry development projects ensure global trade, transportation, and environmental stability. The maritime industry forms the backbone of the worldwide economy, handling over 80% of international trade goods. However, modern challenges such as climate change, growing demand for environmentally clean technologies, and automation require the industry to implement innovative solutions. Managing such projects demands a comprehensive approach that considers the multifaceted nature of processes and the need for sustainable development.

The 5C model (Context, Concept, Collaboration, Commissioning, Continuity) forms a holistic approach to project management, allowing for systematic evaluation of external and internal factors while primarily focusing on the staged achievement of goals with consideration for long-term sustainability (Fig).

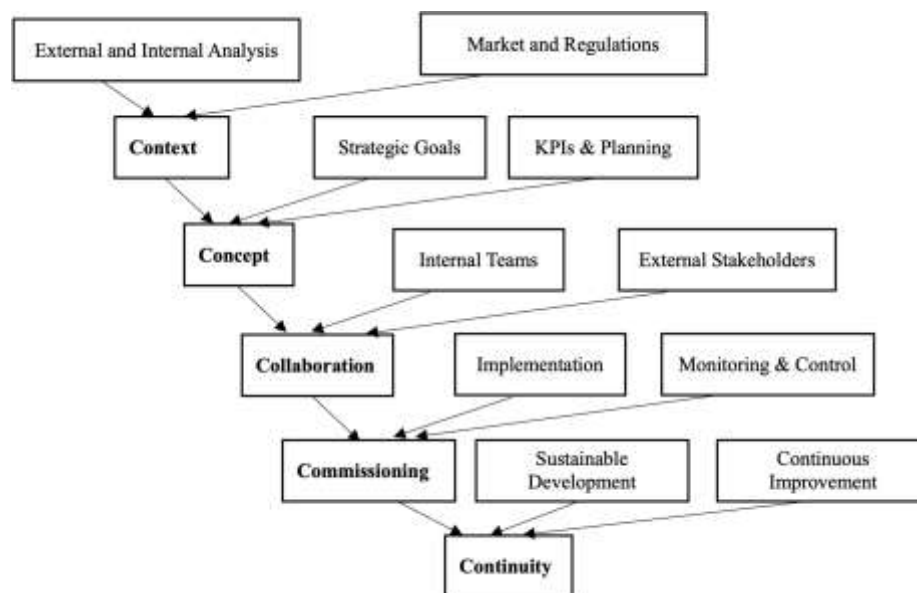


Fig. – 5C Model Implementation Stages in Maritime Industry Development Projects

During the context analysis process, special attention is paid to evaluating external and internal factors affecting the project [1]. External analysis includes macroeconomic indicators, global trade trends, international regulatory requirements and environmental standards, technological innovations, and industry digitalisation. An important aspect is studying the competitive environment and market dynamics, including geopolitical factors and trade relations between countries. Internal analysis focuses on assessing the technical condition of the fleet and port infrastructure, personnel qualifications, and management system effectiveness. Particular attention is paid to analysing financial resources and investment opportunities and evaluating operational efficiency and service quality.

The main project objectives are defined at the concept formation stage, and specific tasks for their achievement are developed. Strategic planning includes formulating a clear project vision and mission and establishing long-term and short-term goals [2]. The operational planning process involves developing detailed implementation plans, establishing key performance indicators, and determining necessary resources and budgets. An essential element is creating an effective monitoring and controlling task implementation system.

Collaboration is critically important for successful project implementation in the maritime industry. Internal interaction involves forming effective project teams and precise distribution of responsibilities among participants. Special attention is paid to establishing department communication channels and creating personnel motivation systems. External interaction means partnerships with ports and logistics companies and cooperation with regulatory bodies and classification societies. An important aspect is establishing effective interaction with suppliers, contractors, and clients.

The commissioning stage focuses on the practical implementation of developed plans and necessary changes. Technical implementation includes developing detailed specifications and requirements, implementing new technologies and systems, and modernising existing infrastructure considering modern environmental standards. Process management involves creating an effective quality management system, implementing optimised operational procedures, and developing emergency action plans [3].

Ensuring continuity is a key factor in the long-term success of maritime industry development projects. Sustainable development is achieved through implementing environmentally clean technologies and optimising resource use. Significant attention is paid to personnel development, employee qualification improvement, and continuous improvement of processes and systems.

Implementation of the 5C model provides numerous substantial advantages for maritime industry organisations. The systematic approach ensures comprehensive consideration of all activity aspects and balanced decision-making. The model's flexibility allows adaptation to changes in the external environment and quick response to new challenges. Focus on sustainable development contributes to achieving long-term goals while considering environmental responsibility and social sustainability. Efficiency improvement is achieved through resource use optimisation and operational performance enhancement, leading to cost reduction. Ensuring effective collaboration creates synergistic effects and promotes the involvement of all participants in the project implementation process.

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DEVELOPING PERSONALISED LEARNING AND SKILLS DEVELOPMENT STRATEGIES USING AI.

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Behavioral competencies are essential to effective project management, as they help ensure teamwork, make informed decisions, and maintain communication between stakeholders. Key competencies include leadership, communication skills, stress tolerance, adaptability, and emotional intelligence [1]. Developing these skills helps project managers improve their performance, helps them better understand the team's needs, and keeps them highly motivated. Artificial intelligence (AI) plays an important role in creating individual learning paths that take into account the characteristics of each student or employee.

The main goal of this study is to explore the possibilities and prospects of using AI to develop personalized learning strategies and competence development.

Personalized learning is a process in which educational content is adapted to the needs, interests, and level of knowledge of the learner. Today, many platforms, such as Moodle, Canvas, and Google Classroom, allow for a partial implementation of an individual approach. However, the integration of AI significantly expands the capabilities of these systems.

To effectively develop and implement personalized learning strategies, it is advisable to use AI at each of the following stages:

- 1) data collection and analysis based on previous learning outcomes, questionnaires, etc;
- 2) planning to identify needs, key competencies, and learning objectives;
- 3) adaptation of learning content to educational goals and needs, for example, development of materials of different levels of complexity;
- 4) monitoring using AI to continuously analyse progress and make changes to the personalised learning strategy.

AI provides in-depth analysis of data, such as learning history, level of learning, pace of work, and offers recommendations for optimising the learning process. For example, adaptive algorithms identify knowledge gaps and create personalised learning paths. Chatbots integrated into learning platforms provide timely assistance by answering students' questions in real-time. The developed models of personalised assistants, pre-trained on specific sources, will save time in searching for the necessary information.

In the course of the experiment, generative AI models such as Chat GPT (version 4.0) [2], Gemini [3], and Deepseek [4] were used to analyse leadership skills of masters of the project management program in the field of information technology. To do this, students filled out questionnaires that were attached to the generative models in turn with a request to analyse the students' questionnaires and provide recommendations for improving the leadership skills of future project managers.

All three generative models in one of the questionnaires identified and focused on strengths with explanations of which questionnaire question was responsible for a

particular ability. For example, «among the strengths are the ability to take responsibility, organisational skills and the desire for independence. For example, the answers to questions 16 and 43 indicate a deliberate approach to decision-making and a willingness to see things through». They also highlighted problem areas: «however, weaknesses such as lack of self-confidence, indecisiveness and conflict avoidance can hinder effective team management. This is evident in the answers to questions 14, 19 and 33, where people admit that they may get lost in situations of disagreement or avoid heated discussions» [4].

Next, generative models suggested ways to improve the respondent's leadership skills: «it is recommended to focus on developing self-confidence, communication and decision-making skills. Courses on effective communication, conflict management, and emotional intelligence will be effective. Practical exercises, such as public speaking, active listening, and case analysis, will help, to consolidate theoretical knowledge. It is also important to work on confidence through a success diary and relaxation techniques to reduce stress» [3-4]. The Deepseek model offered a selection of books that would provide an in-depth understanding of leadership principles. The GPT chat offered a monthly plan to improve time management skills and training to improve public speaking.

In the next experiment, in order to determine leadership qualities, generative models were asked to analyse the work done by students on the topic «Ideal project manager. My vision». Students chose the option of implementing the task independently. For the study, generative models chose a text format and infographics. In both papers, the AI identified weaknesses in risk management skills and the quality of recommendations to deepen knowledge of decision-making methodologies in project management and English language skills.

Artificial intelligence opens up great opportunities for developing personalised learning strategies that help build the necessary competencies of a project manager. Effective implementation of AI in education requires close cooperation between teachers, students, and technology developers.

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RESEARCH OF APPROACHES TO DESIGNING A SUPPORT SYSTEM FOR USERS OF AN INTERNET RESOURCE

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User support systems for Internet resources are an integral part of their operation and interaction with visitors to the websites of commercial and state-owned enterprises and organizations, public authorities, etc. A preliminary analysis of support systems for Internet resources of commercial institutions, in particular online stores, has shown that such companies spend significant financial resources to create highly efficient and functional user support systems. In this regard, there is a need to study approaches and justify the choice of the most effective forms of support systems for users of Internet resources.

Customer support for companies can take various forms. Selber St., Johndan J., and Brad M. (1996) identified two most common types, namely paper and online, considering the segmentation and target needs of the main user groups. With the development of technology and the Internet, customer support tools have expanded through the more effective use of chatbots, query management systems, recommendation algorithms, etc.

The design of an effective support system for users of online resources depends on the goals and functions of the system, which can combine end-user support and service desk services.

Since the main purpose of online customer support systems is to track and effectively respond to customer requests and complaints, the most popular forms of customer support include community forums, communication via social networks and messengers, phone support, email, publishing customer reviews, live chat support, chatbots, and digital assistants based on artificial intelligence, CRM systems, publishing feature articles and help center instructions, and hosting a FAQ section.

In general, there are several models of support systems for users of Internet resources, namely:

- 1) self-service model, which involves the use of knowledge bases, FAQs, and reference books on the website;
- 2) interactive support model, which includes customer interaction with real operators or chatbots;
- 3) a model based on hybrid solutions.

In designing and implementing models of a support system for users of an online resource, one can also distinguish such approaches as implementing proactive support and assistance in advance (before the client's request), integration with communities, and provision of multichannel service.

Today, one of the most popular tools for supporting customers and users of online resources is various chatbots, which can be implemented by placing appropriate buttons and pop-up forms on the website. Web-based customer support chat can be either «live», involving communication between the user and an agent specializing in the subject of the request, or using digital assistants.

The choice of a particular tool depends on the needs of clients and the financial capabilities of the company or organization. A small local company with a youth target audience may initially communicate with customers via messengers and social media (e.g. Instagram). At the same time, large companies or corporations can use omnichannel platforms to process customer requests (such as Zendesk), or develop their comprehensive support system to cover all possible communication methods.

The study identified the following challenges that may affect the choice of forms of customer support for online resources:

- 1) ensuring the speed of response to user requests (including 24/7);
- 2) personalization and individuality of the approach to customer service, maintaining a history of communication;
- 3) processing of non-standard customer requests;
- 4) taking into account cross-cultural and regional peculiarities of user behavior;
- 5) support for multilingual service for different international markets;
- 6) ensuring the confidentiality and security of services.

The development of generative artificial intelligence technologies and the creation of digital assistants based on them can help solve problems related to the personalization of customer service and support for multilingual service. According to Cassidy K. (2024), the expected effect of using a multilingual digital assistant in comparison to traditional call centers and service desks can be both a personalized global experience of a chatbot and improved accessibility of the brand itself.

In 2024, companies such as Google, Apple, and Amazon were among the most famous manufacturers of digital assistants with artificial intelligence. A promising area of application of this technology is the introduction of a system for analyzing large volumes of feedback and requests.

In general, the implementation of a user support system should be carried out in a comprehensive manner, taking into account both the specifics of the online resource and the number of requests and available resources.

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AUTOMATION OF DOMAIN-DRIVEN DESIGN PRINCIPLES: NEW MODELS

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Modern software systems are rapidly increasing in complexity due to growing demands for scalability, adaptability, and business logic integration. This complexity often leads to challenges in maintaining consistency across teams and modules, especially in large-scale projects. Domain-Driven Design (DDD) is an approach that addresses these challenges by structuring software architecture around the core business domain. By emphasizing concepts like bounded contexts, aggregates, and a ubiquitous language, DDD ensures a clear alignment between software components and business requirements. However, despite its theoretical advantages, implementing DDD in real-world projects often reveals significant obstacles.

A common issue is the lack of clarity in maintaining the boundaries of bounded contexts. As projects scale and new team members join, it becomes increasingly difficult to preserve the integrity of these boundaries. Violations of aggregate principles and the inconsistent application of the ubiquitous language exacerbate these challenges, leading to semantic discrepancies, redundant code, and poorly defined interdependencies. These problems contribute to higher technical debt, increased maintenance costs, and inefficiencies in collaboration across teams.

The goal of this research is to address these challenges by introducing automation into the application of DDD principles. Specifically, the proposed methods and models aim to formalize the core principles of DDD, enable their objective verification, and ensure consistent adherence throughout the software development lifecycle. By achieving this, the study seeks to improve key metrics, including reduced code complexity, minimized duplication, streamlined maintenance efforts, faster implementation of business requirements, and more efficient onboarding of developers.

The methodology for this research is built on three pillars: formalization, ontological modeling, and CI/CD integration. Formalization involves representing aggregate relationships through dependency graphs. These graphs allow for a structured visualization of interactions between aggregates, making it easier to identify violations of bounded context boundaries. For example, when one aggregate begins to depend excessively on another, this dependency can be flagged for review.

Ontological modeling is another critical component. Inconsistent terminology is a significant source of miscommunication and errors in software projects. To address this, ontologies are used to enforce adherence to a ubiquitous language. This approach ensures that all team members and components of the codebase use consistent and well-defined terms, reducing semantic errors and improving overall code readability.

The third pillar is the integration of these automated checks into CI/CD pipelines. Continuous integration and deployment processes provide an ideal

framework for real-time validation of code against DDD principles. Automated tools can scan code for violations, such as unapproved dependencies or deviations from the agreed terminology, at each stage of development. This proactive approach prevents issues from escalating and ensures that compliance is maintained throughout the project lifecycle.

The results of this research highlight the effectiveness of automating DDD principles. One significant outcome is the improvement in code quality. By reducing code complexity and duplication, teams can produce cleaner, more maintainable code. This, in turn, reduces the time and cost associated with debugging and maintenance. Another notable benefit is the enhancement of team collaboration. With a consistent terminology and clear architectural boundaries, communication among developers becomes more efficient, minimizing misunderstandings and conflicts in the codebase.

The integration of these tools into CI/CD pipelines has also proven to be a transformative step. Automated validation enables teams to detect and address issues early, reducing the risk of technical debt and ensuring that changes to the codebase do not introduce new violations of DDD principles. Additionally, the use of dependency graphs and ontological models provides valuable insights into the system's architecture, allowing for more informed decision-making during development and maintenance.

In conclusion, the automation of Domain-Driven Design principles represents a significant step forward in the creation of high-quality software systems. The proposed methods and models not only bridge the gap between DDD theory and practice but also offer a scalable and practical solution for modern software development. By formalizing aggregate interactions, ensuring terminological consistency, and integrating compliance checks into CI/CD pipelines, this approach delivers tangible benefits in terms of code quality, team collaboration, and project scalability. Future work may focus on extending these methods to support diverse architectural styles and adapting them to specific domains, such as healthcare, finance, or logistics. This research demonstrates that the automation of DDD principles is not just a theoretical concept but a practical pathway to achieving robust, efficient, and maintainable software systems.

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IoT TECHNOLOGIES FOR ENVIRONMENTAL MONITORING OF FREIGHT TRANSPORT

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Modern freight transport is an integral part of the global logistics system, but its impact on the environment is becoming increasingly evident. According to the European Environment Agency, the transport sector accounts for over 25% of all CO₂ emissions in Europe. This problem is incredibly relevant for Ukraine as well. In light of growing demands to reduce environmental impact and improve transport energy efficiency, the implementation of innovative technologies is an urgent necessity. One promising solution is the creation of an IoT system for monitoring the environmental sustainability of freight transport.

The urgency of addressing this issue is further underscored by the global commitments to combat climate change, such as the Paris Agreement, which seeks to limit global temperature rise by reducing greenhouse gas emissions. Freight transport, as a key contributor to CO₂ emissions, has become a focal point for both policymakers and industry leaders. The integration of advanced technological solutions into transport systems is not only a response to environmental challenges but also a strategic move toward meeting international sustainability goals.

Additionally, the growing economic and technological interdependence among countries makes it essential for national logistics systems to align with global standards of environmental performance. Ukraine's strategic location as a transit hub between Europe and Asia positions it uniquely to leverage innovative IoT systems [1]. By adopting advanced monitoring and optimization technologies, Ukraine can enhance its role in international logistics while addressing pressing environmental concerns.

The primary goal of the development is to create a system capable of not only providing real-time control of transport's environmental performance but also offering recommendations to enhance its operational efficiency.

The main objectives are:

- collect data on harmful emissions, fuel consumption, and engine performance;
- analyze the collected data in real-time;
- detect anomalies and generate optimization recommendations;
- automatically generate reports in compliance with international environmental standards.

Methods and technologies from sensors to cloud platforms. To achieve the set goals, the system integrates modern hardware with powerful analytical platforms and user-friendly interfaces.

I. Hardware.

- emission sensors (detect levels of CO₂, NO_x, C_mH_n, and other harmful substances).
- GPS trackers (monitor routes, speed, and movement conditions).

- fuel sensors (provide fuel consumption control and identify possible leaks).
- weather sensors (consider the impact of external factors (temperature, humidity)).

II. Cloud Platform.

The system utilizes cloud technologies such as AWS or Google Cloud to process large volumes of data in real-time. Using machine learning algorithms, the system forecasts equipment conditions and generates route optimization recommendations.

III. User Interfaces.

Web and mobile applications provide convenient access to data, enabling managers and operators to monitor the transport's condition and plan its operation. Integration with ERP systems and logistics platforms via API makes the system even more functional.

The implementation of the IoT system contributes to achieving significant results in various industries. Logistics companies, for instance, gain the ability to control emission levels in real-time, optimize fuel consumption, and detect technical issues early. In the construction industry, this allows for reducing the environmental impact of heavy machinery and enhancing economic efficiency.

The development and implementation of IoT systems come with certain technical challenges. One of them is ensuring the accuracy of sensor operation in challenging conditions, such as low temperatures or high air pollution. Special materials and technologies are used to enhance equipment reliability. Another challenge is integrating IoT systems with outdated infrastructure. In response, adapters and universal APIs have been developed to ensure compatibility.

The proposed IoT system offers significant prospects for sustainable development. Its scaling and enhancement, particularly integration with automated fleet management systems, will further reduce the negative impact of transport on the environment. Future research will focus on improving data analysis algorithms and developing new forecasting methods.

Conclusion. Integrating IoT technologies into freight transport is not only a means to reduce environmental impact but also a tool to enhance company efficiency. A system combining modern sensors, cloud technologies, and machine learning algorithms has the potential to become a key element in the environmental transformation of the transport sector. Implementing such innovations is an important step toward a sustainable future.

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ALGORITHMS FOR MANAGING REQUIREMENTS FOR IT PROGRAMS AND STRATEGIES THROUGH BRM INTEGRATION INTO THE SOFTWARE DEVELOPMENT AND MANAGEMENT LIFECYCLE

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Software development in modern conditions is a complex and multifaceted process that requires the integration of a large number of factors, such as growing customer requirements, limited resources, deadlines and the need to quickly adapt to market changes. A particular difficulty is the need to constantly align strategic business goals with technical aspects of development, which requires effective communication between business units and IT teams. In this context, the concept of Business Relationship Management (BRM) plays a key role as a tool for improving interaction between these parties. Traditional management approaches, such as Waterfall, are often unable to provide the necessary flexibility in decision-making, while Agile and DevOps focus on the speed of development, neglecting strategic alignment of goals. The growing complexity of IT products and the growing requirements for their functionality necessitate the development of new approaches to project management.

According to a study by the Standish Group (2023), only 35% of IT projects are completed successfully, that is, within the planned budget, deadlines and with all requirements met[1]. The rest of the projects face budget or deadline overruns, and 19% fail altogether. The main reason for failures in 47% of cases is ineffective requirements management, which leads to a mismatch between customer expectations and development results. In addition, according to the PMI report (2022) [2], conflicts between business needs and technical constraints are the cause of more than 40% of delays in software development. They arise due to insufficient interaction between business and IT teams, which complicates the decision-making process and often requires significant resources to correct initial design errors.

BRM offers an effective approach to solving these problems by ensuring transparent communication between business stakeholders and technical teams[3]. This not only aligns strategic goals with technical capabilities, but also reduces the number of requirements changes in the later stages of development. According to a study by Gartner (2023) [4], organizations that implemented BRM were able to reduce budget overruns by 23% and shorten development times by 17% due to a clearer integration of business goals into development processes. The novelty of the BRM approach lies in the use of iterative algorithms that provide flexibility and rapid adaptation to changes in requirements or market conditions. Such algorithms allow you to constantly monitor the status of the project, quickly identify problems and adjust plans.

The main challenges in requirements management are requirements volatility, resource constraints, poor communication between business and IT teams, insufficient consideration of changing priorities. In addition, the implementation of

new technologies is often complicated by the lack of agreed integration and management mechanisms.

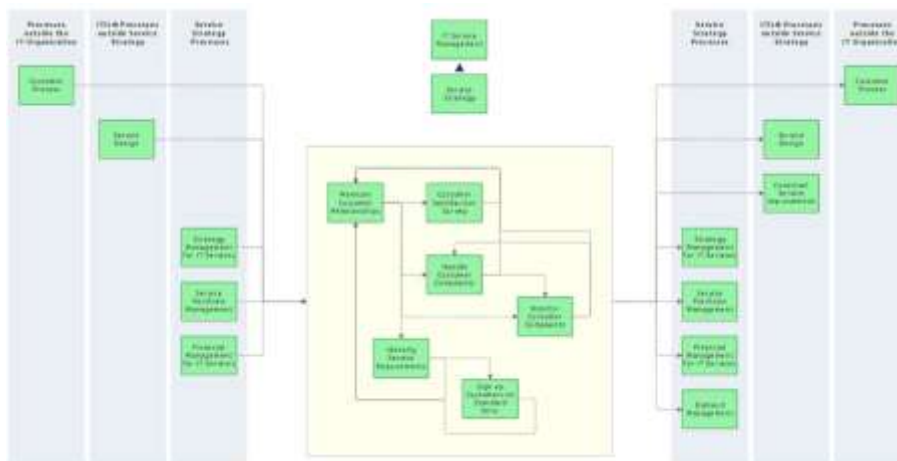


Fig. 1 – ITIL business relationship management diagram [5].

The requirements management process, enhanced by the Business Relationship Management (BRM) approach, is a systematic method for ensuring that developed software products fully meet business needs. This process includes several key stages that are closely related to each other.

At the initial stage, detailed information about the customer's needs is collected. This is achieved through interviews with key employees, organizing joint work sessions (workshops) and analyzing existing documentation. The data obtained is carefully analyzed in order to identify key requirements for the future software product. An important aspect of this stage is the integration of requirements with the company's overall business goals. This ensures that the development is aimed at achieving the strategic goals of the organization. After the requirements are defined, an assessment of the resources required for their implementation is carried out. Available human resources, financial resources and technical resources are analyzed. Based on the data obtained, a detailed resource utilization plan is developed, which ensures the effective use of each resource. Not all requirements have the same importance. Therefore, the next step is to prioritize them. For this, various methods are used, such as cost-benefit analysis and stakeholder voting. Prioritization allows you to focus efforts on the most important requirements and optimize the development process. A development plan is formed based on prioritized requirements and available resources. Modern approaches to software development involve the use of adaptive methods, such as Agile. This allows for flexible response to changing requirements and ensures rapid delivery of value to the customer. The development plan is divided into iterations, each of which has clearly defined goals and completion criteria. The development process is iterative. At each stage, progress is assessed, feedback from stakeholders is collected, and necessary adjustments are made to the plan. This ensures that the product being developed is exactly what the business needs.



Fig. 2 – Strategic House with Business Relationship Management [6].

Integrating BRM into the software development process allows you to achieve significant results in improving product quality, reducing costs, and ensuring strategic alignment between business and IT. Thanks to BRM integration, the development process becomes more business-oriented, which allows you to create higher-quality products, bring them to market faster, and reduce the risk of project failure. Adaptive requirements management algorithms that underlie BRM provide process flexibility and allow you to quickly respond to changes in the business environment.

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DEVELOPMENT OF A MODEL FOR STUDYING THE IMPACT OF EXTERNAL INFLUENCES ON THE OPERATIONS OF BUSINESS ENTITIES AS AN ELEMENT OF THEIR STRATEGIC STABILITY

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In today's rapidly evolving external environment, businesses constantly face a variety of factors that can either facilitate their growth or pose threats to their operations. The interaction between external influences and internal business processes is a complex and multifaceted phenomenon that requires a systematic approach to analysis and risk management.

External factors, which we will refer to as «external influences», often impact not just a single process but entire groups of processes, leading to a variety of consequences that require specific measures and response strategies. For instance, an external influence that may result in economic, social, legal, and financial consequences for an entity cannot simply be classified as an «external risk». Instead, it represents a broader concept that necessitates in-depth research and analysis. Therefore, this study proposes a broader perspective on the concept of «external influence», while the potential consequences – both negative and positive – will be examined through the lens of the concept of «derivative risk resulting from the development of influence».

Thus, the derivative risk resulting from the development of influence (a definition proposed by the author) refers to a specific event of either a positive or negative nature (opportunity or threat) that manifests itself and consequently exerts a cause-and-effect impact on the business processes of a particular economic entity, but only in the event of the occurrence of the considered external influence.

For effective management and adaptation to changes, it is essential to apply comprehensive research methods that not only identify external influencing factors but also assess their potential development and impact on the business processes of the economic entity.

For this purpose, a research model for the development of external influence has been developed as a tool for structured analysis, forecasting potential derivative risks, and assessing the impacts of external influences on business operations (see Fig. 1). The proposed model enables the following: identifying and classifying external influencing factors; evaluating the risks and opportunities arising from changes in the external environment; formulating response strategies to threats and leveraging opportunities.

The proposed model illustrates the relationship between external influences and the business processes of an economic entity through the mechanism of derivative risk. The model takes into account the potential for both negative (threat or danger) and positive impacts on the system.

External influences (black cloud). Represent any external factors that may impact a company's operations. These may include economic, political, social, environmental, and technological factors.

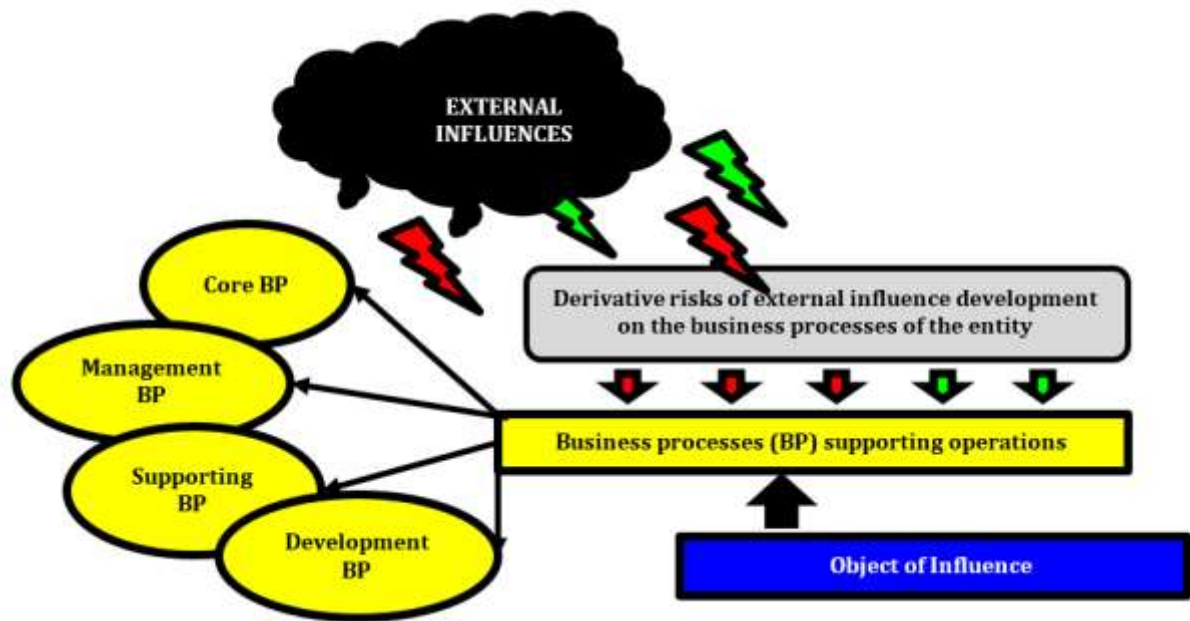


Fig. The research model for the development of external influence on the activities of an economic entity

Derivative risks of external influence development (gray rectangle with black text). These arise as a result of external influences and can have either a positive or negative nature. They impact the business processes of the entity by altering their efficiency, productivity, or resilience.

Business processes supporting the entity's operations (yellow rectangle). This category includes the analysis of core business processes, management business processes, supporting business processes, and development business processes.

Object of influence (blue rectangle). This is the final element of the system that is targeted by influences through business processes. It may undergo changes as a result of derivative risks.

Mechanism of influence. External influences manifest as potential threats or opportunities. Through the system of business processes, these influences can lead to various derivative risks, represented by red arrows for negative impacts and green arrows for positive impacts. The outcome of this interaction results in changes to the state of the object of influence, which are reflected in specific consequences for its operations.

The developed model enables the identification of potential threats and opportunities within the external environment, considering economic, political, social, technological, and environmental factors that may impact the company's operations. It helps to: identify critical points within business processes that are most sensitive to external influences, ensuring timely responses and enhancing their resilience; forecast the development of risks and evaluate possible scenarios of their realization, which supports the creation of effective crisis management strategies.

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