Digital economy: theory and practice
Цифровая экономика: теория и практика

IMPLEMENTATION OF ARTIFICIAL INTELLIGENCE TECHNOLOGIES IN CORPORATE FINANCE: CLASSIFICATION BY SPHERES OF ACTIVITY

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Abstract. The article considers the meaning of artificial intelligence technologies, such as machine learning, deep learning, natural language processing plus robotic process automation and data analytics. This is done for understanding of AI technologies functions in their implementation in corporate finance of an enterprise. According to the literature review, machine learning is mainly used in reconciliation, validation, analysis, and forecasting; RPA and intelligence process automation − for KPI management, transaction processes and compliance; NLP − for speech and text recognition in different operations. Based on the analysis of the technological development prospects of the largest financial companies, consulting bodies, professional associations, and educational structures, such as ICAEW, CPA Australia, CPA Canada, ACCA and SigmaIQ, the relationship between AI technologies and business processes of such companies is systematized. A classification is proposed in relation to the introduction of AI technologies in the areas of corporate finance in the financial sector and specific tasks to be solved in each area. Namely, in the areas of: accounting (accounts receivable management, accounts payable control, reporting, financial planning and analysis), external finance processes, internal audit, forensic accounting and fraud detection, work of CFO. The main benefits of such technological implementation are also defined for three groups: efficiency, control and decision-making. Significance of the study is expressed in the most concrete classification of AI technologies implementation in corporate finance, which allows harnessing the benefits specified. However, the article does not cover such topics as prerequisites, problems of implementation and their solution, because these questions were discussed in previous articles of the authors. Future research could be viewed as description of real implementation evidence in business environment, complicated with constraints of the economic reality.

Keywords: artificial intelligence, management of innovations, finance, accounting, business analysis

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ВНЕДРЕНИЕ ТЕХНОЛОГИЙ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В КОРПОРАТИВНЫЕ ФИНАНСЫ: КЛАССИФИКАЦИЯ ПО СФЕРАМ ДЕЯТЕЛЬНОСТИ

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Аннотация. В статье рассматривается значение технологий искусственного интеллекта, таких как машинное обучение, глубокое обучение, обработка естественного языка, а также роботизированная автоматизация процессов и анализ данных. Это сделано для понимания функций технологий искусственного интеллекта при их внедрении в корпоративные финансы предприятия. Согласно обзору литературы, машинное обучение в основном используется для согласования, валидации, анализа и прогнозирования; автоматизация процессов RPA (robotic process automation — роботизированная автоматизация процессов) и IPA (intellectual process automation — интеллектуальная автоматизация процессов) — для управления ключевыми показателями эффективности, транзакционными процессами и соблюдением требований; NLP (natural language processing — обработка естественного языка) — для распознавания речи и текста в различных операциях. На основе аналитики перспектив технологического развития крупнейших финансовых компаний, консалтинговых органов, профессиональных ассоциаций и образовательных структур, таких как ICAEW, CPA Australia, CPA Canada, ACCA и SigmaIQ, систематизирована взаимосвязь между технологиями искусственного интеллекта и бизнес-процессами таких компаний. Предложена классификация в отношении внедрения технологий искусственного интеллекта в области корпоративных финансов в финансовом секторе и конкретных задач, которые необходимо решить в каждой области. А именно, в областях: бухгалтерского учета (управление дебиторской задолженностью, контроль кредиторской задолженности, отчетность, финансовое планирование и анализ), внешних финансовых процессов, внутреннего аудита, выявления мошенничества, работы финансового директора. Основные преимущества такого технологического внедрения также определены для 3 составляющих: эффективность, преимущества контроля и принятия решений. Значимость исследования выражается в наиболее конкретной классификации внедрения технологий искусственного интеллекта в корпоративные финансы, которая позволяет использовать указанные преимущества. Однако в статье не рассматриваются такие темы, как предпосылки, проблемы внедрения и их решение, поскольку эти вопросы обсуждались в предыдущих статьях авторов. Будущие исследования можно рассматривать как описание реальных кейсов внедрения в бизнес-среде, осложненных ограничениями экономической реальности.

Ключевые слова: искусственный интеллект, менеджмент инноваций, финансы, финансовый учет, бизнес анализ

Introduction

Programming and technological skills shape the future of different fields of economy, and finance is no exception [1, 2]. The question for this article was how to deal with such technologies, artificial intelligence particularly, which of them are the most important and transformational, whether or not some of them are applicable now, how they could develop further, how they could change the current financial working framework. Therefore, according to the previously published article about prerequi-

sites, problems of implementation and their solution for AI technologies, now the research focused on classifying such technologies by the particular spheres for determining tasks and content of their work [3]. Thus, the problem could be stated as understanding the meaning, content and outcomes of artificial intelligence technologies in different realms and task types of financial sector.

The relevance of the study is justified by absence of articles and scientific outlooks on implementation of AI technologies particularly in finance sector, describing the mechanism and meaning of their work [4, 5]. Thus, this research was done for IT-specialists, accountants, business-analysts, auditors, forensic specialists, CFO and all people interested in optimization of finance functions in terms of speed, cost, flexibility, consistency and accuracy.

Literature review

First of all, we should define the terms we are going to discuss, because the right understanding of their meaning is the key in identification of their difference from currently widespread economic programs and their special features. In general, researchers describe AI (artificial intelligence) systems as the machines that mimic human cognitive functions like thinking, understanding, reasoning, learning and problem solving; in most cases, they far supersede human efforts, however they fail to fully replicate the human intelligence [6]. Machine learning (ML) is a related term and is known as a sub-set of AI emphasizing the ability of the system to learn from the data input and perform better over time, continuously improving itself without being explicitly programmed by people. DL (deep learning) and NLP (natural language processing) are deemed to be the sub-fields of ML, handling more complex unstructured data, for example, pictures and voice [7]. Deep learning is characterized by using neural network model (like neurons in the human brain) to learn at deeper levels from the large amount of data. The artificial neural networks (ANN) are based on the model of biological neural network, and thus are built up of many layers of nodes – data pieces; the flow of algorithm or signal can pass up and down such levels from the level of input to the output layer, analyzing the data in it. Thus, the term DL captures the number of layers between input and output – the depth of ANN.

It is also important to understand how the ML and particularly DL systems work. They develop some formulae (models) that can leverage historical data to make predictions about future situations. Such models can self-adjust to new and changing patterns as external data systems evolve. Thus, the process looks like the one presented in Fig. 1 [8].

The NLP technology as the part of ML means recognizing unstructured data by:
— speech recognition (voice to text conversation)
— natural language understanding and interpretation (providing comprehension of texts given)
— machine translation.

There is also another noteworthy AI term – robotic process automation (RPA). RPA is in fact a programmed software automation tool that, like high-end Excel macros, handles high volume, low complexity, repeatable tasks tirelessly, quickly and without errors. This technology is not an AI sub-field. However, there is also IPA (intelligent process automation), which, like RPA, is predictive, self-aware and self-healing, making it a sub-set of AI [9].

The range of all definitions presented above could be illustrated by Fig. 2 and it is essential for the future understanding to distinguish between these terms.

The second question, interesting for all financial professionals, is how such systems can help specialists and what is the main aim and possible results of implementing them. As we already mentioned, the main opportunity we can seize using these systems is continuous improvement of the everyday tasks of the department, company, business, industry and finally economy by learning-based data-driven systems [10]. In the short-term, researchers say AI is focused on:
— improving efficiency (reducing arduous and tedious tasks, freeing employees to work on high-priority ones, resulting in lower costs and more value);
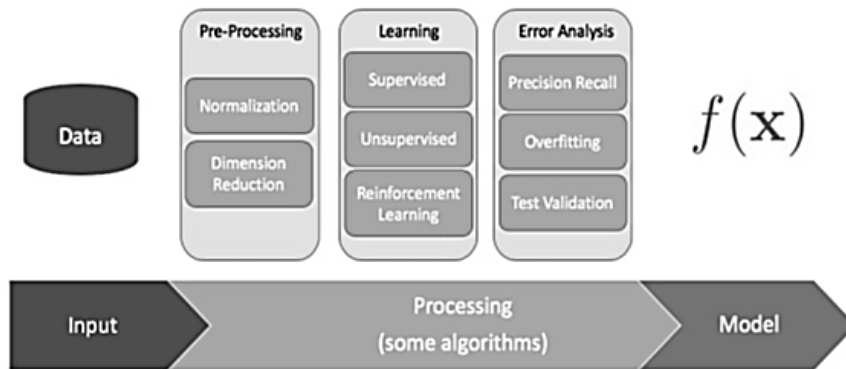
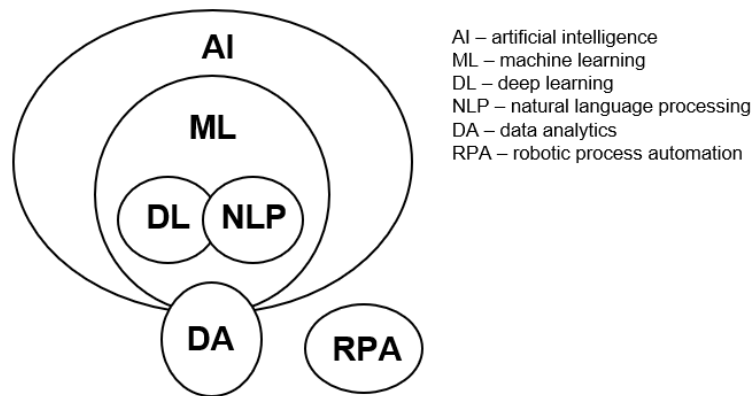Fig. 1. Processing scheme of machine learning technology [8]

AI – artificial intelligence
ML – machine learning
DL – deep learning
NLP – natural language processing
DA – data analytics
RPA – robotic process automation

Fig. 2. Range of artificial intelligence sub-technologies [7]

— providing more valuable and accurate insights for further use by humans (identifying patterns for improvement and driving decisions to increase performance).

Nevertheless, in the longer term, consultants expect systems to take over a great chunk of decision-making tasks, thereby superseding humans [11].

In addition, the authors of the articles being analyzed stress out that AI systems are useful not only for companies, but also for investors (for obtaining confidence in the financial results of companies and ensuring they are correct) and governments (to ensure the correct taxation level and to establish continuous tax monitoring) [12].

Summarizing the results of the literature review, it should be emphasized that the analyzed publications are mainly devoted to the characteristics of advanced technologies and their role for the company's financial activities. The purpose of this study is to deepen the existing knowledge about the applicability of technologies in the field of corporate finance and to identify the correlation between a particular technology and a specific financial business process in general and in relation to such functions of the company's financial and economic activities as accounting, external financial processes, internal audit, forensic accounting and fraud detection, and CFO functions.

Materials and methods

The research on description and classification of implementation spheres was done based on the analysis of outlooks of the biggest financial companies, consulting bodies, professional associations and

educational structures such as ICAEW, CPA Australia, CPA Canada, ACCA and SigmaIQ. Other methods include logics, systematization, classification and synthesis to present thorough results.

Results

The results part comprises two different classification of AI implementations in finance. The first classification shows the abilities of concrete AI sub-technologies in financial sector operations – classification done by technologies.

Let us start with the machine learning, it can transform such operations as:

1) cash/intercompany reconciliation;
2) judgement-based journey entry validation;
3) spend optimization;
4) payables/receivables analysis;
5) marketing analysis;
6) performance forecasting.

RPA and IPA can do:

1) finance transactions processing;
2) cross-function / control and compliance workflow management;
3) journal entry validation;
4) revenue management.

NLP can change such operations as:

1) control/exceptions management (as a virtual agent);
2) finance query management (as a virtual agent);
3) finance helpdesk (recognizing speech);
4) automated contract/purchase order management (analyzing text);
5) social media (analyzing text and context).

All operations mentioned above reflect the definition and the main aim of systems discussed, therefore they are reasonable and shape the implementation issues and determine the main benefits of the systems we cover further.

For the best understanding of perspective of human–technologies interaction it is rather useful to observe the main realms AI systems can take over, and the main problems they are going to solve. This is the second type of classification – implementation of AI-technologies by realms of financial sector and concrete tasks.

Let us start from accounting. The first type of tasks connected with order-to-cash or accounts receivable include:

1. Mastering customer data by RPA bots – collecting info from e-mails, workflow forms; validating for completeness; routing for approval; updating systems.

2. Order processing by IPA bots – extracting and processing data from unstructured info sources.

3. Cash application by RPA bots – downloading bank files; entering or uploading data; matching payments to remittances and summarizing items.

4. AR reconciliations by IPA bots – validation and reconciliation of data across billing systems, CRM and ERP systems [13].

The second type of accounting tasks is connected with procure-to-pay or accounts payable:

1. Mastering vendor data by RPA bots – collecting info from emails, workflow forms; validating for completeness; routing for approval; updating systems.

2. Invoice processing by IPA bots – extracting and processing data from unstructured info sources.

3. Payment processing by RPA bots – creation and editing of payment proposals, checking for duplication and sending payment notice to vendors.

4. Reconciliation and analysis by IPA and AI – sample checking of receipts; identification of fraud risk upfront [14].

Third type of accounting activities is reporting or general accounting consisting of:

1. Journal entry processing by RPA – checking for the completeness; preparation automation and parking to ERP or CRM systems.

2. General ledger reconciliations by IPA – downloading statements from external sources; reconciliation of transactions with ERP or CRM systems; creation of balancing entries for handling discrepancies.

3. Intercompany accounting by IPA – checking and reconciliations of counterparty sheets; creation exception reports.

4. Financial reporting by RPA – data extraction and aggregation automation; preliminary analysis; spot checking.

5. Management reporting by IPA – downloading financial accounting ledgers and enriching them with necessary additional info; creating trend and variance analysis reports [15].

Fourth and final type of tasks pertinent to accounting activities is financial planning and analysis:

1. Planning and budgeting by RPA – data distribution and collation with patterns; basic completeness checks; variance and sensitivity analysis [16].

2. Forecasting by AI tools – analyzing historical data on internal and external drivers (production portfolio, competition, macroeconomics, nature and history events); generation of new insights (costing, pricing, sales, cash flow, profit gaining strategies); data visualization enabling self-service and proper reporting [17].

The second realm AI is going to revolutionize in finance scope is external finance processes including:

1. Connection with banks – identification of optimistic trends of organization activity or market environment, probably resulting in foreign exchange or interest rate flux; forecasting events and predicting alerts or warnings; dynamics analysis and managing hedging instruments.

2. Connection with tax authorities – classification of documents, checking GL and payroll files to estimate necessity and volume of payroll tax; warning on areas possibly contravening tax laws; identification of risky transactions and tax treaties applicability [18–20].

The third important financial sphere is an internal audit and AI is powering such tasks as:

1. Customer data protection – minimizing threats and keeping systems up-to-date.

2. Anomaly detection – proactive search for anomalies and discrepancies [21].

3. Predictive analytics – alert generation and blocking suspicious activities in real time [22].

Logically, forensic accounting and fraud detection is the fourth relevant financial sphere to change in the near future by implementing AI and its sub-sets in order to proactively detect and swiftly respond to procurement fraud, payroll fraud, expense reimbursements, fraudulent financial reporting, bribery and corruption, financial crimes:

1. Anomaly detection and clustering by DL of structured data.

2. Unstructured data analysis by NLP and computer vision.

Finally, the fifth largest scale financial sphere to implement AI is the work of CFO:

1. Assuring intelligent finance – touchless processing, reconciliation and allocation of financial data; continuous accounting, closing stocks and compliance; real-time self-service analysis and reporting; predictive forecasting and rapid planning; driving real-time insights on resources; freeing up employees for value creation [23].

2. Leading digitalization efforts and innovation in digital factories or incubation of ideas – the best overlook of operations in that field is presented in Fig. 3 [24].

3. Development of the future finance talent to manage post-digital finance function.

Discussion

Thus, the results of the study are presented, and we can discuss their meaning. Apparently, computer systems are designed as to be better than humans in different aspects. Let us have a look at various advantages separated by specialists into different groups:
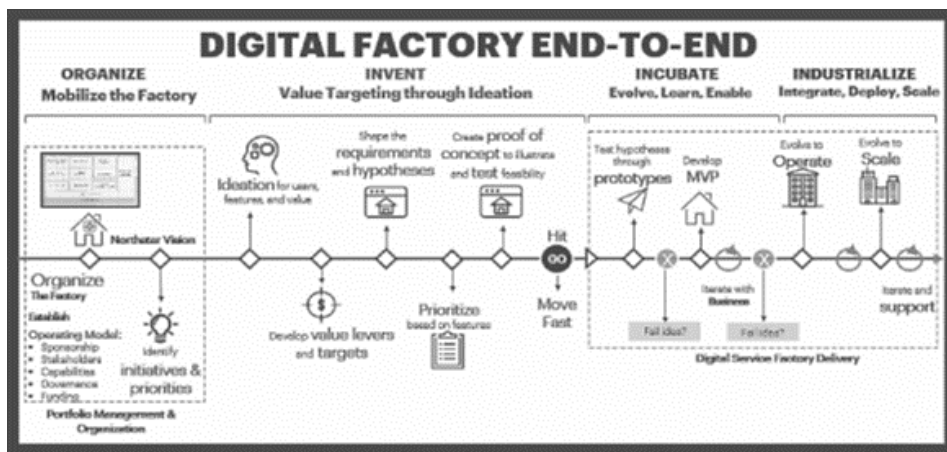
Efficiency benefits:

Fig. 3. Representation of factory digitalization using artificial intelligence sub-technologies [10]

1. Speed — velocity far surpassing human processing activities.
2. Cost — technologies are much cheaper than employees in the time horizon.
3. Flexibility — consistently matching demand volatility.
4. Volumes — ability to process and analyze the largest data sets than ever before.
Control benefits:
1. Consistency — assurance of identical processes, elimination of spontaneous variations.
2. Audit trail — full maintenance of logs essential for compliance verification.
3. Confidentiality — nondisclosure of sensitive personal information.
4. Freedom from prejudice — elimination of human physically, psychologically and socially-based biases.
Decision making benefits:
1. Insight — providing thorough advanced analytics.
2. Accuracy — great scrutiny guarantee.
3. Knowledge retention — implementation of historical learning in current algorithms.

Hence, all these benefits could be harnessed by using AI technologies in finance sector. The meaning of results is in better understanding which particular technology serves your tasks and needs.

Significance of the results lies in possible economy from optimization of processes and finding right technological solution before investment.

Future direction of research is connected with description of implementation process for particular technologies in individual spheres, realization of methods of problem-solving (possible problems were thoroughly discussed in previous article) [3, 25].

Conclusion

In terms of the results, we reviewed the content and tasks artificial intelligence sub-technologies can present, classified this information by technology implementation and spheres of work in financial sector. Main benefits were also stated, as well as links to the previous articles about prerequisites, problems of AI implementation and their solution given.

Directions for further research

As for the future research, we could suggest a description of real implementation evidence in business environment complicated with sanctions, curtailed program infrastructures, and other constraints of the current world economics.

In particular, the authors intend to create a method for AI optimization of foreign trade procedures in a company, description of technologies implementation scheme, possible problems and methods of their solution.

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