

Review Paper

# Using Artificial Intelligence in Terms of Individual Stages of the Raw Material Supplier Selection Process

Artem Lopatin<sup>1\*</sup>, Nataliia Ishchenko<sup>1,2</sup> and Liudmyla Nazarova<sup>1</sup>

<sup>1</sup>Department of Economy and Entrepreneurship, Petro Mohyla Black Sea National University, Mykolaiv, Ukraine

<sup>2</sup>Department of Management and Marketing, Durham University, Durham, United Kingdom

\*Corresponding author: art-lopatin@meta.ua (ORCID ID: 0000-0002-2707-9033)

Received: 09-01-2023

Revised: 27-04-2023

Accepted: 03-05-2023

## ABSTRACT

The purpose of this research is to develop and justify the model of using artificial intelligence in terms of individual stages of the raw material supplier selection process in Ukraine. The research used both general scientific and specific methods: methods of logical generalisation, systematization, comparison, analysis and synthesis, methods of graphic representation, etc. The following conclusions were made as a result of the study: clarifying the exact stage, where artificial intelligence should be used in the process of selection of the raw material supplier. Based on different studies on the topic, definitions of "material supplier selection process" were grouped by approaches and shortly reviewed. Based on this definition, an original definition was given, and it was therefore concluded that specific actions should be performed. It was established that no general definition for artificial intelligence exists in contemporary science due to various existing issues. Also, artificial intelligence is used in different fields and has its distinguishing features. After analyzing them, artificial intelligence was divided into subclasses, based on which a model of the artificial intelligence's usage, when choosing the material supplier was suggested. These conclusions would bring practical value when improving Ukraine's prioritized fields, such as food, medical and military industries.

## HIGHLIGHTS

- The relevance of the research is caused by declaring the Fourth Industrial Revolution at the World Economic Forum in 2016, which suggests automation in manufacturing processes.

**Keywords:** Model optimization, commercial offer, concept of interaction, financial and business activities, Fourth Industrial Revolution

Today, the process of the choice of the raw material supplier demands is particularly significant due to, firstly, with a key meaning of the given process in the context of building an effective system of entrepreneurship management based on expense reduction. Besides, the optimization of the raw material supplier selection process is updated because of the following factors: change of the essence, content, and concept of interaction with a multiplicity of suppliers or a selection of one reliable and long-term supplier which satisfies the conditions of well-timed delivery and quality, and also corresponds to the conditions of the

general paradigm of enterprise activity; the need to make a balanced management decision about the cooperation with suppliers due to increasing in their variety with the levelling of differences among suppliers in terms of delivery, offer, etc.; the demand of the enterprise, that is cooperating with suppliers, when entering the market, form the commercial offer itself, and at the same time

**How to cite this article:** Lopatin, A., Ishchenko, N. and Nazarova, L. (2023). Using Artificial Intelligence in Terms of Individual Stages of the Raw Material Supplier Selection Process. *Econ. Aff.*, 68(Special Issue): 805-810.

**Source of Support:** None; **Conflict of Interest:** None



minimize the expenses and raise the effectiveness of own activity. The described tendencies cause, in turn, the need to choose ways of product quality raising and expense reduction, beginning with the raw material supplier selection process. The solution to this problem is possible with the help of artificial intelligence tools, which therefore makes the present research relevant.

The analysis of scientific papers dedicated to the problem of artificial intelligence usage in terms of individual stages of the raw material supplier selection process showed that nowadays, there are fundamental researches on the issues of using artificial intelligence in financial and business activities of enterprises. It is studied in the works of such scientists as M.M. Velykanova (2020), M.F. Yefremov and Y.M. Yefremov (2008), A.K. Pohorelenko (2018), O.V. Poznyak and K.O. Melnyk (2020), Y.V. Volynchuk and I.O. Kudelya (2020). The problem of the optimization of the raw material supplier selection process was addressed in the scientific works of O.A. Karpenko (2018), D.M. Kondratyuk (2014), A.O. Lopatin (2020), O.V. Matsyshyna and I.I. Nahorna (2020), V. Cherepov (2012). A significant scientific contribution was made by the listed scholars: the basic definitions of the theoretical foundations of artificial intelligence were clarified, the views on the severance of stages of the raw material supplier selection process were generalized, the substantial content of the selected stages was systematized.

The aim of the article is to develop and to justify of the model of using artificial intelligence in terms of individual stages of the raw material supplier selection process. To reach a set goal, the following tasks were set: to systematize the views on defining the concept "the raw material supplier selection process"; to give own definition of the concept "the raw material supplier selection process"; to specify the substantial content of the stages of the raw material supplier selection process; to justify the general scheme of using artificial intelligence in terms of individual stages of the raw material supplier selection process; to suggest the model of using artificial intelligence in terms of individual stages of the raw material supplier selection process.

## MATERIALS AND METHODS

The methodology of this research is represented

by a set of methods which are used to achieve the general goal. In the process of the following research, both general scientific and specific methods was used. Thus, in order to specify the basic concepts and the substantial content of the stages of the raw material supplier selection process such methods as of logical generalization, systematization, comparison, analysis and synthesis were used; to justify the model of using artificial intelligence, in terms of individual stages of the raw material supplier selection process, the methods of graphical presentation, systematization and comparison were used.

To examine Ukraine's state and perspective of regional transportations markets (as of 2020), the following scientific and special methods were applied: huge part in researching the state regional transportation market was played by the cluster analysis, which was used due to its simplicity and the specifics of economic data, which needs to be analyzed. The cluster method is divided into subgroups and was developed by multiple authors, whose ideas are continued to be used today.

The other methods are: abstraction method – needed to understand and reason the core of the regional market of transportation; systematic method – used for justification of local transportation markets' organization, as well as defining the factors that influence on those markets; static analysis methods were used for defining the tendencies that influence regional transportations markets and correlation analysis for the amount of influence of those tendencies; taxonomy method, that was needed to define the state of local transportation markets; cluster analysis method to rate country's regions by the level of development of transportation markets and because this method makes it easier to analyze a large portion of information; method of regression analysis and method of scenario approach were used to predict activities and development on regional transportation markets (Kosina, 2020; Popov, 2018; Honcharenko, 2020).

The scientific methods, used to explore law specifics and potential problems connected to using artificial intelligence for supply selection in Ukraine, are: systems analysis was used to explore different situations that arise when using artificial intelligence to solve problems and to establish the relationship between artificial intelligence and the law; logical-

dogmatic method and hermeneutics method were needed to interpret and connect if the scientific idea of artificial intelligence to such works like: analysis of the European Parliament resolution of 16th February 2017, recommendations to the commission on civil law rules on robotic analogue approach, with comparative approach, which was needed to explore the possible harm that artificial intelligence.

## RESULTS

### **An analysis of the management of the raw material supplier selection process**

The analysis of modern scientific literature dedicated to the problem of concept definition “artificial intelligence”, showed that a single approach in the given definition interpretation was not available, and the theoretical basis of the given issue is generally characterized as the undeveloped scientific element. The described problem is caused by the following factors: theory straggling comparing with a rapid development of the scientific and technological progress; the problems of inviolability of the private life and as a result limitedness of the access to the results of artificial intelligence usage; absence of legislative regulation in the sphere of using artificial intelligence etc. A detailed attention is required by the most urgent approaches of the artificial intelligence, which are being implemented in artificial intelligence systems via various methods and algorithms. Among the main ones, the following should be distinguished (Pohorelenko, 2018): tasks presentation and systems development; artificial intelligence software; natural language understanding and problem-solving; images identification; development of natural language interfaces and machine translation; robotics and intelligent robots; machine education and self-study; independent planning and scheduling; offline control; medical diagnostics; supply planning; games and machine creativity.

It should also be noted that general artificial intelligence should have such cognitive functions as the ability to determine the aim of its functioning independently, and even not just an aim, but a set of aims, both interconnected and correlated, and absolutely independent. And in the process of achieving the aim, the general artificial intelligence, like a human, should be able to change the content

of the aim dynamically as a result of changes in both internal and external circumstances (Yefremov and Yefremov, 2008). In the era of great demand uncertainty, high risk of non-delivery and increase in competitiveness, the excellence of the raw material supplier selection process often depends on an organization’s ability to integrate and arrange the whole spectrum of final processes of purchasing materials or components, turning them into ready products and delivering them to customers. Since this ability can be improved by enhancing transparency throughout the whole raw material supplier selection process, many leading organizations are trying to enrich their information sources and share real-time information with partners.

In this way, the management of the raw material supplier selection process becomes more and more dependent on the information and its focus is aimed at asset replacement (for example, commodity and material values, warehouses, transport equipment) with the information. Acknowledging the growing importance of information for streamlining of the raw material supplier selection process, foreign scientists and specialists investigated different means of better information management and using it for making better business decisions. Artificial intelligence can be considered one of them, as it has existed for decades but was not fully used in the raw material supplier selection process. Individual cases of artificial intelligence technologies are the following ones, as usage of neural networks methods, machine studying and rough set theory.

Some spheres of artificial intelligence, such as expert systems and agent-based systems, can be useful for work with different aspects in the raw material supplier selection process. In total, artificial intelligence in the raw material supplier selection process comes to computers using in the aim of judgments, samples identification, studying or understanding certain behaviors from experience, acquirement and conservation of knowledge, and also developing various forms of conclusions to solve problems in decision-making situations in order to optimize the raw material supplier selection process. In other words, the main aims of artificial intelligence in the raw material supplier selection process are the following ones: to understand the phenomenon of the human intellect and to develop

computer systems which can imitate the behavior models of the human and create knowledge that is related to solving the given problems of the raw material supplier choice.

At the same time, the special features of such systems lie in their narrow specialization in certain tasks. Therefore, it means that artificial intelligence must have an opportunity to study and comprehend new concepts, learn from experience (“on its own”), perform judgments, make conclusions, assign meanings and interpret symbols in the context. Thanks to this ability, artificial intelligence is successfully used in such spheres as games, semantic modelling, human efficiency modelling, robotics, machine studying, data communication, neural networks, genetic algorithms (GA) and expert systems. Using artificial intelligence technologies in the raw material supplier selection process nowadays needs studying, as already a major part of European companies and companies of the USA uses the following technologies, and they also plan its usage in the future. In turn, researches of domestic companies on the subject of using artificial intelligence technologies, in terms of supplier selection and in general, are still not covered.

Thus, one of potential spheres of artificial intelligence use, which has not been sufficiently investigated yet, is new philosophy of management of the raw material supplier selection process, which demands comprehension of complicated interconnected processes of decision-making and creation of intellectual knowledge foundations, which both have a crucial meaning for common problems’ solution. For example, Eastman Kodak structured the thinking processes of experienced order selectors and then developed a rule-based expert system of choosing the selection method of the optimized order size in the warehouse, that improves the work with the raw material supplier, subject to information transparency (Haefner *et al.* 2021).

The number of problems can be classified according to a three-level hierarchy of decision-making (Rykovanova, 2021): strategic decisions, which fall within long-term issues of the executive level, such as strategic alliances, facility location and capital investments; tactical decisions, which fall within intermediate issues of middle level managers, such

as common demand planning, supplier selection and stock planning etc.

Artificial intelligence means the ability to think as a human, to act as a human, to think efficiently and act correlatively, this means achieving goals in a number of changing circumstances. This way, according to these peculiarities of artificial intelligence, it can be additionally classified into a number of subclasses: artificial neural networks (ANN); rough set theory (RST); “human thinking” (HT); three-level hierarchy (TLH); machine studying (MS); expert systems (ES), genetic algorithms (GA); ambiguous logic (AL); agent modelling (AM) (Yevstyhnyeyeva, 2018).

The suggested model of artificial intelligence usage in terms of individual stages of the raw material supplier selection process will contribute to the optimization of the artificial intelligence usage process on every separate stage of the raw material supplier selection process. The advantages of the substantiated model are: detailing of the model not only by specified stages but also by individual phases of the stages of the raw material supplier selection process; taking into account the purpose of using artificial intelligence at each stage of the process while building the model, which allowed for making the most effective model in terms of efficiency; the comprehensive nature of the developed model, based on the consideration of all modern artificial intelligence tools that can be used in the raw material supplier selection process in order to ensure the efficiency of this process.

## DISCUSSION

In this article, the original definition was given, which points to the exact role and aim of artificial intelligence usage in the management system. It also diverges by providing stages that artificial intelligence goes through to select the best supplier and by presenting the model of the AI selection process. It is also pointed out that this new approach to material supplier selection may help understand human intellect more – which is a logical conclusion since the choice that AI makes and how it does so would be compared to how a person would think because the artificial intelligence developed to make decisions and think resembling human thinking – as mentioned in A.K. Pohorelenko’s (2018) article about artificial intelligence.

In some articles, which used for this work, stages for choosing the supplier have been listed. For example, in A.O. Lopatin's (2020) article on modern methods of the supplier selection, it is established that companies should have good relationships with already chosen suppliers starting from stages of developing products, so that the work of AI be optimized as well.

Also, based on different authors' conclusions, it can be understood that there are still things to improve for artificial intelligence. For example, A.K. Pohorelenko (2018) and N.M. Novikova (2018) write that AI now cannot predict the result of its own mistakes, as it is unable to recognize factors outside of its algorithms.

It is also concluded that developing AI may still open new interesting possibilities. In different articles (Pohorelenko, 2018; Al-Zubaidi, 2019; Velykanova, 2020; Kosina, 2020), it was mentioned that some companies were already using artificial intelligence for their purposes. It is mentioned by A.K. Pohorelenko (2018) in her article about application of artificial intelligence, that AI is already being successfully used for other spheres of life, other than in logistics. For example, AI helps people in Israel avoid traffic jams or can diagnose more than 50 eye illnesses by one retinal image.

In I. Al-Zubaidi's (2019) article on supplier relationship management, it was mentioned a company that already does use AI while working with suppliers. The company's name is "Happy Home" (a supply company from the UK) developed its own AI to monitor orders and spare time, by answering basic supplier inquiries.

It was also noticed, that both Ukrainian and foreign articles that are used in the research (Pohorelenko, 2018; Al-Zubaidi, 2029; Velykanova, 2020 Kosina, 2020), have examples of companies that use artificial intelligence in foreign companies, but any mentions of Ukrainian companies which use AI is available. That is why O.V. Poznyak and K.O. Melnyk's (2020) article about informational technology applied to Ukrainian economics is so useful – it names the perspective and prioritised industries in which the technology would be helpful for Ukraine. Another interesting and useful aspect is lawful – because it should be considered, especially since the usage of AI supply selection was suggested to such industries like medicine and military.

In the article on AI and innovation management (Haefner *et al.* 2021; Potapenko, 2013) it was considered the opportunity of an artificial intelligence replacing a human in innovation management and then concluded that it would be problematic for AI to replace the human managers' judgment. It was also stated that at the same time, human management without artificial intelligence help may be too stressed and overburdened with information to understand the new product and make wrong decisions. In O.V. Posnyak and K.O. Melnyk's (2020) article on AI in economics, it is mentioned that in the sphere of logistics, managers should always double-check the AI's selection, because in this sphere, the social factor should always be taken into account.

In N. Haefner's *et al.* (2021) article it was mentioned a company that could have missed an opportunity and discovered it only by accident. Then it was concluded that not using artificial intelligence makes companies potentially lose opportunities and even cause their downfall.

Despite the possible issues AI can bestow, using it brings more benefits and its application is inevitable. The word and the logistics processes have changed – companies in technologically developed countries are using different technologies for businesses, so companies in Ukraine would need to do so as well in order not to lose competitiveness. Also, the structure of companies is changing, so that at some point usage of artificial intelligence for analyzing the optimal supplier would not only be more efficient, but in some cases is the only option (because there's too much data for a person to analyze in a short time).

## CONCLUSION

The research was developed and justified the artificial intelligence usage model in terms of individual stages of the raw material supplier selection process by clarifying the stages of this process and their meaningful content, as well as by coordinating individual artificial intelligence tools, the purpose of their use with the distinguished stages and phases of the raw material supplier selection process. After different definitions on "the raw material supplier selection process" were analyzed, the original one was introduced. It differs

from the existing ones with the specification of the place in the general management system, the essential characteristics and the aim of the process. Skills that are required for AI to accomplish the task were named. It was concluded that AI could be divided into subclasses. Problems that AI have to solve when choosing the suppliers were distinguished. Based on this information, a model of using artificial intelligence for suppliers' selection was presented. At the same time, regarding the direction of further research, it is reasonable to indicate the necessity of adapting this model to the crisis conditions of functioning of Ukrainian enterprises, which is a very relevant issue today. In researches made for Ukraine, the industries for which this approach is preferable to apply are: pharmaceuticals, which not only would make the supplier selection process better, but also improve the storage conditions of medicine. Optimize the food supply, with consideration of ripening of the crops and its preservation. And the optimization of army logistics, to make the process of supply safer and quicker.

The integration of AI into the logistics process would need further improvement of algorithms, in general. Analysis of possible consequences of AI's errors, because the AI cannot see full consequences itself – it is not developed to include factors that are outside of its algorithms yet. It would be required to update the law, to regulate new technology in logistics. It is also desirable to consider social problems that may emerge when AI takes some work from people.

## REFERENCES

Al-Zubaidi, I. 2019. *Supplier Relationship Management (SRM)*. Stanford University, Stanford.

Cherepov, V. 2012. Selection of suppliers of goods. *Goods and Mark.*, **1**: 23-29.

Haefner, N., Wincent, J., Parida, V. and Gassmann, O. 2021. Artificial intelligence and innovation management: A review, framework, and research agenda. *Tech. Forec. and Soc. Chang.*, **162**: 120392.

Honcharenko, A.D. 2020. Management of purchasing activities at the enterprise. *Youth Econ. Bull. of Simon Kuzn. Khar. Nat. Univ. of Econ.*, **12**: 54-57.

IT-Enterprise. 2020. <https://www.it.ua/knowledge-base/technology-innovation/supplier-relationship-management-srm>(Last Accessed on 10<sup>th</sup> April, 2023).

Karpenko, O.A. 2018. Study of the advantages of the logistic approach in the organisation of logistics systems of enterprises. *Econ. of Ind.*, **2**: 11-17.

Kondratyuk, D.M. 2014. The optimal supplier as a factor in the competitiveness of enterprises. *Econ. Manag. Innov.*, **1**(11).

Kosina, K.G. 2020. *Assessment of the State and Development of Regional Transportation Markets*. Vasyl Stefanyk Precarpathian National University, Kharkiv.

Lopatin, A.O. 2020. Modern methods of choice of supply of raw materials by land transport. *Probl. of the Syst. Appr. in Econ.*, **4**(78): 57-63.

Matsyshyna, O.V. and Nahorna, I.I. 2020. Organization of the supply of material resources to the enterprise, pp. 220-221. *In: A collection of abstracts of the 1<sup>st</sup> international scientific and practical conference*. Politehnika, Kyiv.

Novikova, N.M. 2018. The choice of suppliers of commodity resources of the trade enterprise. *Pryaz. Econ. Bull.*, **4**(9): 43-48.

Pohorelenko, A.K. 2018. Artificial intelligence: Essence, application analysis, development prospects. *Bull. of the Khar. State Univ.*, **32**: 22-27.

Popov, I. 2018. *Justification of the choice of a potential supplier as a factor of increasing the sustainability of the enterprise*. Lviv Polytechnic National University, Lviv.

Potapenko, A.V. 2013. *Development of a model for forecasting the development of transport systems taking into account the variability of their components*. Kharkiv National Automobile and Highway University, Kharkiv.

Poznyak, O.V. and Melnyk, K.O. 2020. Logistical aspects of artificial intelligence in the management of strategical goods. *Sci. View: Econ. and Manag.*, **3**(69): 153-158.

Rykovanova, I.S. 2021. *Logistics of supply of production equipment to the enterprise*. Lviv Polytechnic National University, Lviv.

Velykanova, M.M. 2020. Artificial intelligence: Legal issues and risks. *Bull. of the Nat. Acad. of Legal Sci. of Ukr.*, **27**(4): 185-198.

Volynchuk, Y.V. and Kudelya, I.O. 2020. Logistics management of the supply process at enterprises. *Young Sci.*, **6**: 12-17.

Yefremov, M.F. and Yefremov, Y.M. 2008. Artificial intelligence, history and development prospects. *Bull. of Zhyt. Polytech. State Univ.*, **2**(45): 123-127.

Yevstyhnyeyeva, O.A. 2018. Supplier selection as one of the methods of optimising logistics costs. *Young Sci.*, **28**: 23-26.