DIGITAL TECHNOLOGIES IN PROCUREMENT: HOW TO ENSURE EFFICIENT MARKET RESEARCH?

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Abstract

Artificial intelligence today has become a tool suitable not only for solving household and industrial problems, but also for optimizing and improving the efficiency of business processes. Using the example of the procurement of high-tech metallurgical products, the article demonstrates the areas of effective application of artificial intelligence in a multi-stage international project. The analysis of this procurement as an experiment is combined in the article with inductive generalizations of a practical order and systematization of expert opinions on the role and legal status of artificial intelligence. Rational use of IT does not eliminate a person from the project, but allows you to focus the specialist's attention on expert issues. Big data processing and forecasting possible risks are the areas in which artificial intelligence is able to qualitatively reduce costs and serve to obtain a better result. And modern metallurgy today is one of the most promising industries for the application of this approach.

Keywords: Artificial intelligence, procurement, metallurgy production, logistics, high technologies

1. INTRODUCTION

In practice, the business processes of logistics and procurement are not only closely interconnected, but also largely interdependent. On the one hand, procurement is an important part of logistics work. On the other hand, the quality of logistics operations within the framework of a specific purchase largely determines its efficiency.

Historically, in most European countries, procurement was developed as a pioneer in the adoption of digital technologies. The publication of procurement announcements on the Internet, the acceptance of bids in electronic form, the use of specialized portals for holding auctions in real time, electronic systems for managing interaction with suppliers – all this has long become applied tools for large organizations. Within the framework of such tool as dynamic purchasing, automation of the work on the selection and comparison of offers from potential suppliers can also be mentioned.

By and large, the use of digital technologies in procurement business processes has shown effective. However, at the same time, it is possible to note that the penetration of modern digital technologies in such an important stage of procurement work as procurement preparation, and in particular, preliminary market research, is minimal.

Meanwhile, it is this stage that determines the quality of procurement as a whole, as well as defines the scope and content of the business activities associated with the purchase. For example, if in the course of a preliminary market research it was revealed that there is no competition in the market for the purchased products, then holding a tender for the purchase of these products becomes meaningless – the customer in this situation needs a completely different tool.

Qualitative market research is a necessary condition for quality procurement. At the same time, truly high-quality market research requires the comparison of huge amounts of information. And big data processing today is one of the most promising areas of application of digital technologies.

Of course, the use of digital technologies in general and artificial intelligence in particular cannot be considered a universal tool and "panacea" for all the problems and risks of procurement. The purpose of this article is to determine, firstly, the area of effective application of AI in procurement preparation based on the analysis of electronic tools already used in procurement, and secondly, to formulate the conditions under which such efficiency is possible. The overarching goal of this study is to propose additional measures to improve the quality and reduce the costs of procurement work.

2. EXPLORATION

This study is based on a generalized analysis of existing electronic tools utilized in the field of procurement, and on the application of this analysis to the practice of procurement of high-tech equipment. To this end, following a review of existing digital procurement technologies, examples will be given of the cases from procurement practices in which these tools have proved to be ineffective. It is the identified cases that represent the most promising field for both theoretical research and practical recommendations on the methodology for introducing new digital technologies. At the same time, it is important not only to point out the prospects for the use of e.g. AI, but also to indicate the limitations of its application.

In the 21st century, the introduction of digital technologies in procurement processes has come a long way from experiments in the use of electronic document management to automation and partial robotization of procurement work.

In general, it can be stated that such development meets the principles of a special Resolution of the European Parliament - namely, the idea that research activities in the field of robotics should be carried out in compliance with existing basic rights and implemented in the interests of the well-being of the individual and society [1]. The development of economic relations and related business processes is in the interests of society.

As a result, today there are many digital technologies that are used both for a particular purchase and for the organization of procurement activities of the company as a whole and for managing interaction with its suppliers [2].

For example, today not only the management of individual areas of procurement work with the help of electronic tools can be discussed, but also the fact that leading enterprises have already successfully implemented networks, that “incorporate the entire production processes and integrate ICT systems at different stages of the business planning process, including inbound procurement, outbound procurement, production, marketing and between different organizations (i.e., value networks)” [3].

A good overview of the technologies, together with a systematic view of their current uses, can be found, e.g., in the article by Rejeb et al. (2018). It must be noted that the list of technologies able to optimize procurement work is open-ended, - the procurement business process is such that its efficiency can be increased by methods that have not been used before.

In this context, ‘disruptive innovations’-defined as the changes driven by technology that transforms or displaces existing solutions, processes, etc., across a supply chain or parts of it- are paving the way for more innovative solutions [5]

“Currently, robotics and automatization of mechanical processes and activities are regarded as one of the future development possibilities. These leading-edge technologies have the potential to accelerate existing procurement tools by automatizing transactional processes while increasing the accuracy and urging the procurement function managers to concentrate on related strategic problems. Aside from this, the combined

usage of robotics along with artificial intelligence (AI) and machine learning (ML) clears the way for significant contributions to the field of procurement in supply chain management"[4].

Today, advanced electronic technologies are used in the most of stages of procurement: informing the potential suppliers about the terms of the tender, collecting the proposals, analyzing the proposals, and even working with the contract (e.g., experiments on the introduction of smart contract technologies in procurement work are widely known). All the more surprising is the low level of penetration of advanced technologies into the business processes of such an important stage as procurement preparation.

This stage is important, first of all, because the entire purchase depends on its results. To be more precise, high-quality preparation of the purchase is not a sufficient, but a necessary condition for its effectiveness. After all, a mistake or insufficient elaboration of the future purchase at the stage of its preparation negates the positive effect even from the use of relevant tools at all its subsequent stages.

Can digital technologies such as artificial intelligence help in preparation and procurement? It is possible, but only with the condition that the AI does not replace humans, but is assisting a human. In addition, the nature of the use of digital technologies should be characterized by an individual approach at each stage of procurement.

"The industrial buying process comprises of series of complex, interdependent actions that includes recognition of a need, development of a technical specification, supplier evaluation and final purchase decision [6]"

This means that in addition to analyzing the competitive state of the market and assessing the elasticity of the pricing, it is necessary to assess the following factors during the preparation of the purchase of at least somewhat complex and high-tech products:

1. Availability of manufacturers who specialize in the production of the necessary products.
2. Availability of the necessary experience and technologies at the manufacturer's disposal.
3. Availability of qualified employees and modern equipment at the manufacturer's disposal.
4. The need to involve specialized organizations for the delivery, installation, installation and debugging of the purchased equipment.
5. Possibility of transportation to the place of equipment.
6. Special conditions for storage, transportation, installation, etc.
7. The final composition of the purchasing price is based on the factors described above.

In addition to these basic factors, it is advisable to assess the manufacturer's social and environmental responsibility, its business reputation, the degree of financial stability, and in some cases, auditing of the manufacturer's own supply chains. When purchasing high-tech equipment, each of these factors can affect the overall result.

Most of today's high-tech procurement requires international cooperation. And although transnational deliveries within the EU are greatly simplified, the following risks must be taken into account when preparing the purchase:

1. Risk of violation of the deadlines and quality of equipment manufacturing.
2. Risk of violation of the terms and conditions of transportation.
3. Risk of violation of the deadlines and quality of preparation of technological documentation.
4. Risk of mistakes in the course of acceptance work and execution of acceptance documents.
5. Risk of legal errors in the execution of a multilateral transaction.
6. Risk of errors in accounting for the delivery and acceptance of equipment.

If non-EU countries are involved in the delivery in one form or another, then these risks are inevitably accompanied by the risk of customs clearance and the corresponding additional time costs.

As a practical example, the purchasing necessary for the construction of the MPD magnetic circuit for the NICA JINR project can be considered. This project demanded building a new accelerator complex to study the properties of dense baryonic matter[7].

A magnetic core of the **Figure 1"** (own source JINR) is a prefabricated structure weighing more than 700 tons, which has specific material and magnetic properties. The body of the magnetic circuit is a key part of the MPD detector operating within the framework of the NICA accelerator complex. Both the purpose of this complex and its technical characteristics of the magnetic circuit are highly scientifically intensive. At the same time, it is an example of a metallurgical product of deep processing.

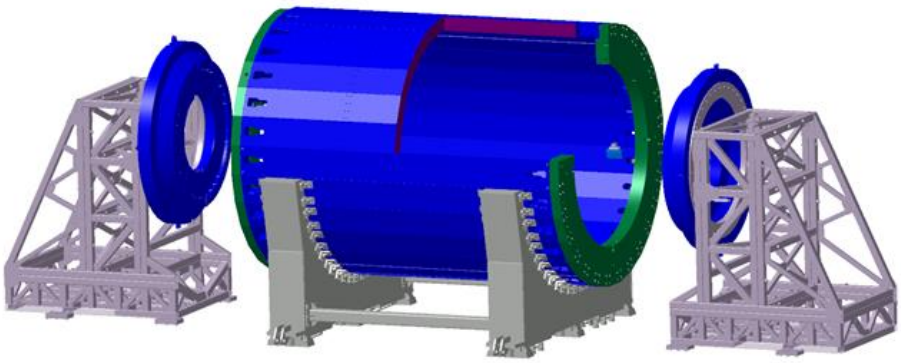

Figure 1. Computer visualization of the design of the magnetic core

JINR, as the leading organization of the NICA project, has developed the design documentation for the future magnetic circuit. According to the design documentation, the manufacturing of the main parts of the magnetic circuit was distributed between two manufacturers, which should manufacture in parallel. This was necessary to meet the deadlines of the project. Plants in Kramatorsk (Ukraine) and Genoa (Italy) were selected as manufacturers.

For the processing of workpieces, the production of the necessary parts and technological equipment, the Vitkovice Heavy Machinery plant (Czech Republic) was chosen. At this plant, the structures ensuring the transportation of individual parts of the product to the place of their final installation were produced.

After manufacturing, the workpieces underwent a complex acceptance testing process. As part of the acceptance, the following parameters were strictly checked for each workpiece:

-dimensions;

-chemical composition;

-mechanical properties;

-magnetic properties.

If at least one parameter is rejected, there could be a threat to the implementation of the entire project. After successful handover at the manufacturing plants, the workpieces were transported to the Czech Republic to the VHM plant. At the same time, taking into account the fact that the workpieces were produced in different countries, it was important to ensure the correct choice of the customs regime for the import of workpieces into the Czech Republic for their subsequent simultaneous processing.

In order to start processing the delivered workpieces, VHM, on the basis of the JINR design documentation, developed its own factory design documentation, which included the following sections:

1. Incoming inspection of workpieces: dimensions measurement, measurement of the geometry of parts, preparation of technical passports.

2. The procedure for processing workpieces.

3. Requirements for the manufacture of parts necessary for the assembly of the magnetic circuit.

4. Requirements for the manufacture of tooling for the assembly and disassembly of the magnetic circuit.

5. Technological map of the control assembly of the magnetic circuit at the VHM plant with the participation of JINR representatives, that included the installation and adjustment of the relative position of the parts of the cradle.

6. Methodology for measuring the horizontality of the base plates and control measurements of plate geometry at various stages of assembly.

7. The order of preparation for shipment: drilling holes and the location of fixing pins after control assembly, marking pins, creating a map of the location of pins, disassembly, packaging, loading, transportation.

On the part of JINR, a temporary customs zone was organized in the area of the Institute for customs clearance of the components imported from the Czech Republic to the territory of the Russian Federation. This step was due to the size and weight of individual parts, which did not allow the specified products to be brought to standard customs terminals.

Finally, after the handover at the Joint Institute for Nuclear Research, the trial assembly of the supplied equipment by the Institute's employees began.

The example briefly described above shows that the complex purchase of high-tech products of the metallurgical industry is a full-fledged multi-stage project in which enterprises from different countries can be involved. This purchase is not limited to a tender, but includes tasks in a variety of areas. For the successful implementation of such a purchase, the following tracks must be taken into account:

- ✓ Technological track.
- ✓ Engineering track.
- ✓ Logistic track.
- ✓ Customs track.
- ✓ Financial and accounting track.
- ✓ Contractual track.

The complexity of the procurement is enhanced by the fact that failure in at least one of these areas makes it impossible for the end user to use high-tech metallurgical products.

What costs and risks associated with the purchase of high-tech products do we see in this example?

First of all, it is the risk of choosing a supplier. An inexperienced, unqualified manufacturer – or simply a factory that does not have the necessary equipment – will not be able to produce the necessary high-tech products.

The second risk is the risk of errors in the technical documentation. Incorrect calculation or even just an incorrect description of the data at one of the stages of manufacturing or assembly can jeopardize the result the entire delivery.

The third risk is the risk of the transportation. It is important to take into account that the dimensions and weight of even individual elements of the described equipment required the involvement of a dozen trucks in the transportation. At the same time, the cost of high-tech products dictated increased requirements for safety during transportation.

Since the purchase of high-tech products is often associated with international cooperation, the risk of customs clearance is adjacent to the logistical risk. And the fact that the end user was a scientific organization located outside the EU only increased the significance of this risk.

Finally, the risk that should not be disregarded is the risk of error in the execution of contractual relations and payments for manufacturing, debugging and transportation. Correct, timely and properly executed calculations in such a purchase are a task that is difficult in itself. Unforeseen offsets and the need, for example, to purchase an additional tool for the contractor from the customer's funds, only increase the difficulties and increase the risk of unintentional error.

There is an uncertainty surrounding procurement decisions due to the large amount of information at the disposition of the firm [8]. This information is the backbone of the procurement process and consists of communications (i.e., obtaining, retrieving, analyzing and distributing information relevant to a purchasing decision) and transactions (i.e., activities related directly to the completion of the actual purchase) [9].

Traditionally, the assessment of all of the above factors and risks is considered to be the area of expertise of a person or a commission of several people. Meanwhile, both the amount of information to be evaluated and the complex nature of the internal connection and the degree of importance of various factors require a large amounts of time from a person to collect and process this data.

In this context, the use of those modern algorithms for processing big data, which are commonly referred to as artificial intelligence, seems relevant and effective for the preparation of the purchase. AI takes incomparably less time to process this data and assess the risks listed above.

In addition to saving time, it is important to consider two other circumstances. First, when human data processing increases, as the number of connections between the objects being evaluated increases, the risk of unintentional error in assessing the quality of these connections and their significance for the delivery results inevitably increases. Secondly, due to the absence and objective impossibility of formalizing the preparation of the procurement to the same extent that tender procedures are formalized, subjectivity of the evaluation is inevitable. At the same time, even for a retrospective audit, it is extremely difficult to separate bona fide subjectivism, dictated by the need for expert assessment, from unscrupulous subjectivism, caused by a conflict of interest and corruption. The use of AI to process big data during procurement preparation allows, if not eliminate, then at least significantly minimize both of these risks.

Of course, in order to work effectively with procurement, AI algorithms must be configured to process big data, taking into account exactly those factors that matter for procurement. This means that for AI to work correctly, it is necessary, firstly, to include an exhaustive list of criteria and methods of assessment in the algorithm, and secondly, to provide it with a sufficient and relevant data for such an assessment.

Therefore, introducing AI into procurement is not an overnight process. After developing a machine learning model, but before using it, it needs to be trained, incl. through saturation with relevant data and examples. After training, testing on e-model examples is necessary. After testing, it is necessary to test it on several pilot purchases. And only if each of these stages is successful, is it possible to gradually introduce AI into procurement practice.

In frequent market research for procurement purposes, this means collecting and structuring information about specialized manufacturers, training an e-model that requires data on production and economic sales from open sources, detailed and specific requirements for processing this data, etc. Only in this case will the e-model be able to provide the customer with high-quality market research results.

But even with such results, the last word should remain not with the AI, but with the expert. AI only speeds up and simplifies that part of the expert’s work that concerns the collection and synthesis of data. The best result of the AI market research is "the probability of becoming a supplier is driven first and foremost by technological

factors, while the importance of procedures and procurement rules is not negligible, but smaller in relative terms" [10].

The effectiveness of the use of AI directly depends on the big data that is offered for its processing. There are several challenges to be addressed, including the following[11]:

• Data heterogeneity including structured data (e.g., statistics and financial records) as well as unstructured data (e.g., text and social media content) sources in various languages with their own vocabulary and formats, such as PDFs, APIs, CSVs, and other ways of storing data;

• Transforming this large and heterogeneous set of data sources into an interconnected knowledge organisation structure using standardised vocabularies and sustainable knowledge integration and sharing approaches, which could be analysed in depth to detect patterns and anomalies.

For a high-quality result, this data must simultaneously meet at least three basic requirements:

1. Objectivity.
2. Completeness.
3. Structure.

Of course, in addition to this, the data must be up-to-date, relevant to the purpose of the purchase, verifiable, measurable if possible, etc. But it is the three requirements mentioned above that are key to the use of algorithms called AI. As Busch et al. mention: “big data involves a range of technologies that enable the management, structuring and usage of data in various ways including the processing of larger volumes of data in a shorter time period and with high precision [5].

The procurement activities provide us with the opportunity to work with such data. To do this, it is necessary not to forget that the introduction of AI into business processes is not a one-time act, but a long-term work. And even before connecting the algorithm for processing big data, it is advisable for the customer to form a database of the very information that is to be processed. “To enable decision makers in procurement to access and utilize large volumes of historical purchasing transactions contracts, pricing information, and supplier performance attributes, big data along with analytics are recognized as important future solutions in procurement” [12].

Such a database should include the information about manufacturers and experience in supplying similar equipment, technical documentation and drawings, installation requirements, information about the results of using the equipment, etc. This information can be largely collected from the materials of previous purchases, which is why the digitization, systematization and storage of such materials is necessary for the implementation of AI.

Of course, the need to use databases does not exclude the involvement of other sources for processing by artificial intelligence, such as the websites of manufacturers and suppliers, official registers, archives of judicial bodies, etc.

3. CONCLUSION

Since procurement preparation creates a multiplying effect, which largely predetermines the quality of procurement as a whole, the introduction of AI into the business processes of procurement preparation can give the same multiplier effect of improving this quality. This is especially important when purchasing high-tech products that require the involvement of partners from different countries.

AI is able to quickly process large amounts of information necessary for procurement preparation, structure the results of such processing based on criteria set by a human, and offer systematic conclusions. However, the quality of AI directly depends on both the creator of its algorithms and the data that the user offers it. Training a machine learning model to select data, training a machine learning model to process data, the form

of presenting the results of data processing - all these aspects directly depend on the expert who prepares the AI for use in procurement work.

In other words, AI is undoubtedly a promising tool for improving the quality of procurement preparation work and significantly reducing the time spent on such work. But at the same time, AI remains a tool in the hands of an expert.

It is important to emphasize that AI should not replace humans either in the preparation of procurement or in other business activities. It is the authorized expert who evaluates the results of information processing by artificial intelligence and compiles the resulting materials for the preparation of the purchase.

The key question is the purpose of the purchase and the purpose of the activity of the expert who conducts this purchase. AI alone cannot improve procurement quality. At the same time, the use of AI, if properly implemented, can increase both the speed and quality of the expert's work. This, in turn, means reducing not only risks, but also business costs, which on a macro scale means increasing the efficiency of production and developing the economy through the applied use of modern technologies.

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