Unified resources marking system as a way to develop artificial intelligence in construction

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Abstract. One of the tasks of the construction organization is timely and complete provision of construction sites with the necessary and high-quality material and technical resources. However, the modern market approach can't guarantee a constant high quality of products at minimal costs. Minimize the risks for construction organizers the authors of the article suggest through the implementation of a system of unified (continuous) marking of construction material and technical resources. A unified system for marking material and technical resources in construction is proposed to be realized through the use of artificial intelligence and special bar codes applied directly to the packaging of building materials. Such a code can contain necessary and sufficient information about the resource, for example, the identification number of the building material or tool, the series of products, the manufacturer, the expiry date or the service life, information that allows tracing the originality of the resource and its quality. Artificial intelligence in the construction industry can become a practical tool for analyzing and managing the supply of building material and technical resources for construction sites, and can also be used as an automated recording of the movement of used and damaged resources. The implementation of a unified marking system for construction products at the enterprise level opens up broad prospects for quality control of the products supplied, maintaining registers of bona fide and unscrupulous suppliers. The implementation of the approach at the level of the whole state opens up new opportunities for combating counterfeit products, collecting statistical industry-wide data, and providing new universal tools for controlling and managing the industry at the federal level. It should be noted that similar projects have already been launched in such areas as pharmaceuticals, fur coats, tobacco products, alcohol.

1. Introduction

Among the main tasks of the construction organization functioning is the timely and complete provision of construction sites with necessary material and technical resources (MTR) [1]. Every year the value of quality perform for the builder only grows. The trend is due to several factors:
   1) infill development's increasing;
   2) decline in construction profitability;

3) the volatility of the exchange rate in the foreign exchange market, which negatively affects the produced abroad materials' cost inside Russian market.

When building a sequence, ensure that MTR is necessary to consider the space-planning decision of the object stipulated by the draft decision on the materials and technologies of work. Also important factors are the potential "pure" risks associated with the theft of materials, the necessity of redoing work, damage to materials and tools.

Every year the fight against counterfeit products in the market of construction materials is becoming more acute. We offer in this article, the system can help to minimize counterfeit products in the market.

In the field of artificial intelligence (AI) the greatest commercial success achieved expert systems and tools for their development. In turn, in this direction the most successful was the problem/subject specialized tools. If in 1988 the income from them amounted to only 3 million dollars, in 1993 more than $ 55 million [2].

Among the specialized information systems based on knowledge, the most significant expert systems are real-time or dynamic expert systems. They account for 70 percent of this market. The importance of real-time defined tools is not only in their rapid commercial success, but also because only through such systems are created strategically important applications in areas such as the management of continuous production processes.

Classes of problems solved by expert systems are: monitoring of real-time systems, top-level management systems, fault detection systems, diagnosis, scheduling, planning, optimization, the operator systems-advisers, design systems.

Therefore, the authors made the assumption that linking all key factors of the construction production logistics in one basket: to collate, calculate the optimal solution in each specific situation for a minimum spending time but with maximum efficiency could AI.

2. Materials and Methods

The authors used a systematic construction industry analysis as the research approach. The work on formation of realized practical approach to construction with the use of modern information telecommunication technologies.

The construction considered by the authors as a system consisting of different parts that interact with each other and exchanging between material resources, which ultimately leads to the construction products production in the specified time and with specified at the initial stage quality. Ensuring the interaction coherence and effectiveness is supported by AI.

Under "AI" at the initial research stage should be understand machine learning, but with an integrated approach - neural networks. Machine learning involves the study of methods for constructing algorithms, able to learn. This approach is used if there is no clear solution. Neural networks refers machine learning algorithms that use a sufficiently large number of computing resources because of the need to consider a large number of factors.

AI has commercial appeal, as it possesses the following qualities:

1. Specialization. The transition from development tools General purpose to problem/subject specialized tools that reduce the development time of applications, increases the efficiency of the tool use, simplifies and accelerates the work of the expert, allows to reuse information and software.

2. The use of traditional programming languages and workstations. The transition from systems based on artificial intelligence languages (Lisp, Prolog, etc.) to traditional programming languages (C, C++, etc.) has facilitated "integration" and reduced the application requirements for speed and memory capacity. The use of workstations instead of PCs has dramatically increased the range of possible applications of artificial intelligence methods.

3. Integrity. Artificial intelligence tools are easily integrated with other information technologies and tools (CASE, RDBMS, controllers, data concentrators, etc.)

3. Results

The introduction of a unified marking system is possible at both the state and corporate levels

At the state level marking system allows

- Assess the real market volume,
- To rehabilitate the industry: to reduce the shadow economy sector to a minimum.
- To maintain the integrity of the producers of materials and tools, producing high-quality products,
- To create a dynamic list of bona fide suppliers and manufacturers.

The introduction of marking fur products have shown that the evaluated before entering the system the market was 15 times less than from the actual current, and the number of manufacturers has been underestimated more than in 3 times.

Minimizing or complete elimination of the informal sector for the production of building materials and tools will lead to increase of tax payments, improving the quality of manufactured construction materials and tools, which in turn will have a positive impact on the quality of the final construction products.

The introduction of marking system at the state level will allow to create an automated system, which will enable construction companies and private customers to trace the whole production chain: from manufacturer, to supplier, and will allow you to be confident in the quality of purchased products.

The unified marking system could be an effective instrument of state policy if it would be used with the information approaches. At the corporate level marking system allows

- to assess available material and technical resources volume in real time,
- to create a dynamic list of high-quality products and reliable suppliers,
- create a real need for material resources as in the quantitative section and in the location context.

On whatever level is not implemented the labelling system, it allows you to fight with counterfeit products. So the fight against counterfeiting in the field of building materials is a priority to work in the direction of the head of the Chuvash Republic, which underlines the relevance of this question.

Artificial intelligence allows you to take on a particular level is the most optimal solution for the minimum amount of time.

To maximize the construction production efficiency is necessary to make the best decisions for different production situations, decisions must be taken in the shortest possible time. To cope with this challenge can AI, which win even a highly skilled Manager, who makes the decision for some time in mind and various factors related to human nature: fatigue, emotions, problems with equipment, workload can influence.

For the development and implementation of AI in the construction industry in terms of the construction companies objectives to ensure the units required inventory, should be performed with these stages

- providing input data to AI,
- giving the AI the ability to track the MTR movement before getting it to the construction,
- site and also directly at the construction site,
- making decisions in the production task.

Consider each stage separately:

1. Providing input data means providing AI necessary and sufficient materials and tools list ranked by title and number. Entering such information can be accomplished in several ways.

The easiest way is to download in AI specifications of materials and equipment, which are assembled manually or using the scheduler (e.g. MS Project). But this approach requires time and constant updating of information that will lead to increasing need for human resources. Another way is to use information modeling construction site. In this case, the "input" data for the AI will serve

directly the information model of a building or structure, where it based on the requirements in material and technical supply.

2. MTR tracking phase involves several sub-steps that follow each other:

- MTR movement from manufacturer to warehouse storage,
- MTR movement from the storage warehouse to the construction site,
- MTR movement inside the construction site,
- used resources accounting,
- spoiled resources accounting,
- timely planning of new MTR.

The authors see that the most optimal solution for the phasing implementation is to equip MTR mandatory marking (QR-code) which would most fully reflect the information about the manufacturer, supply chain, and quickly (by scanning the sign) enter the information about the movement of the MTR on the headquarters of construction.

3. On the existing basis AI data on the location, quantity and quality of MTR information system can optimize production tasks: move MTR from the warehouse to the construction site, correct the construction schedules and supply of materials, and create registers of bona fide suppliers, and others.

The process of learning AI to the solution of production tasks should be maintained through the acquisition, memorization and purposeful transformation of knowledge in the process of learning from experience and adaptation to a variety of circumstances. In other words can be built-in algorithms, who initially "trained" for practical solutions, responsible for staff logistics, and in the subsequent decision is fully automated.

4. Discussion

Russia is actively implemented two-dimensional bar codes, which were developed to encode large amounts of information (Fig.1). For example, the marking system of medicines with the application on the packaging information in the DataMatrix format will become mandatory for all drug manufacturers in 2018-2019.
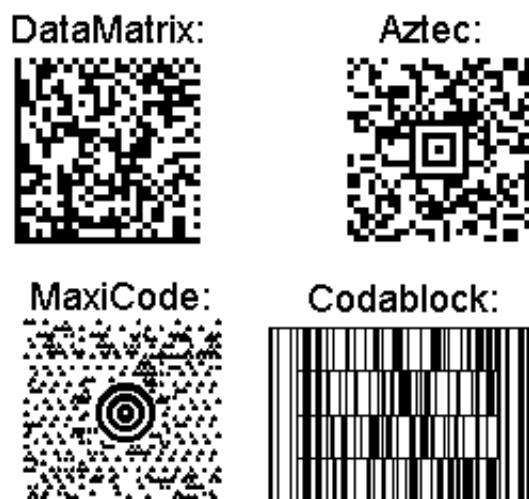

Figure 1. Examples of two-dimensional barcodes.

Two-dimensional bar codes differ, but one thing in common: they can be read both horizontally and vertically. Distinguishing mainly the amount of information that can be recorded on the barcode, and a form of representation: CodaBlock, for example, consists of as if put on top of each other several ordinary, linear barcodes and matrix barcodes allow (for example, DataMatrix, Aztec, MaxiCode) are square with the "scattered" inside the white and black cells..

The authors offer the following information for the application in the form of a bar code:

1. Identification number a building material or a tool.

2. The identification number of the production batch.

3. Shelf life (for building materials).

The construction material identification number can be taken from the classifier construction resources. Identification number of the series of products in the implementation of the system at the state level is formed by the manufacturer of construction materials/tools, when implemented at the level of a construction company within the list of company's partners.

Thus, AI when scanning a barcode receives necessary and sufficient information directly about the MTR, its' manufacturer, expiration date. The aggregate information is about all the existing MTR in the enterprise that could effectively implement the timely and complete provision of construction sites with necessary material and technical resources.

It should be noted that the introduction of the labeling system of construction resources at the state level, can eliminate the problem of counterfeit products or products of low quality that will have a positive impact on the quality of the products.

5. Conclusions

Software tools based on technology and methods of artificial intelligence, widely spread in the world. Their importance, and, primarily expert systems and neural networks, is that these technologies significantly extend the range of practically important problems that can be solved on computers, and their solution brings significant economic benefits.

One of the possible areas of application of AI in the construction industry can be a logistical field of operations and the fight against counterfeit products. AI has all the qualities to become a practical tool for analysis and decision-making system in the field of logistics departments of a construction company, for accounting and movement of used and damaged resources, timely planning of the necessary materials and tools, and for the automation of all processes in the direction and at the state level a uniform system of marking of construction products will contribute to the elimination of counterfeit products and low quality resources

6. Conclusions

References

[1]   Zou P X W, Zhang G, Wang J. Identifying key risks in Construction Projects: Life cycle and Stakeholder Perspectives, , Proceedings of the 12th Pacific RIM Real estate Society Conference, Auckland, New Zealand, 22-25 Jan 2006, 14p.

[2]   Romanov P S. Substantiation of ways of building automated control systems for artillery units on the basis of new information technologies: Monograph. – Kolomna: KGPI, 2005. – 398 p.

[3]   Ginzburg A, Ryzhkova A. Information system of risks analysis and management for construction projects with energy-efficient technologies in use / International Journal of Applied Engineering Research ISSN 0973-4562 Volume 10, Number 21 (2015), Research India Publications, 2015, - pp 41828-41830.

[4]   Rezakhani P. Classifying Key Risk Factors In Construction, Universitatea Tehnică „Gheorghe Asachi" din Iaşi Tomul LVIII (LXII), Fasc. 2 (2012)

[5]   Ginzburg A V. Automation of designing the organizational and technological reliability of construction. M.: SIP RIA, 1999, 155 p.

[6]   Mosly I K. Presentation "Study on risk management for the implementation of energy efficient & renewable technologies in green office buildings"// School of civil, environmental and chemical engineering RMIT University, Australia, 2010, 16 p [

[7]   Ginzburg A V, Automation of the organizational technological design in construction Ginsburg A V, Kagan P B. M.: Publishing house ASV, 2002. - 240 p.

[8]   Ginzburg A V, Tsybulsky O M. System automation of organizational and technological design. / Vestnik MGSU, 2008, №1. – S. 352-357

[9]   Ginzburg A V, Ryzhkova A I. Algorithm of the information system to improve the organizational and technological reliability of construction projects using energy-efficient technologies // Vestnik MGSU. 2016. No. 10. P. 112-119. DOI: 10.22227 / 1997-0935.2016.10.112-119.

[10] Mazur I I, Shapiro V D and others, Project Management, Reference Manual - M .: Higher School, 2001 - 875 p.

[11] Volkov A A. Aktive Sicherheit von Bauobjekten in aussergewhnlichen Situationen // IKM 2000, ABSTRACTS: PROMISE AND REALITY. – Weimar: Bauhaus–Universität Weimar, 2000. – 49 p

[12] Electronic access: "The application of artificial intelligence in the management of construction": http://osp.mans.edu.eg/ELBELTAGI/AI%20Introduction.pdf [10.11.2017]

[13] Electronic   access: "Artificial   intelligence   in   construction": https://jbknowledge.com/artificialintelligence-construction. [15.11.2017]

[14] Electronic access: Chip with fur on the outside Electronic marking of coats has revealed startling information about this market: https://rg.ru/2016/11/30/sebestoimost-shubyokazalas-v-shest-raz-nizhe-prodazhnoj-ceny.html [5.01.2017]

[15] Electronic access: Chuvashia was included in a pilot project on combating illicit trafficking of cable products: http://pfo.volga.news/article/462539.html [30.01.2017]

[16] Volkov A, Chulkov V, Kazaryan R. [et al.]Components and guidance for constructional rearrangement of buildings and structures within reorganization cycles // Applied Mechanics and Materials. – 2014. – Vols. 580–583. – Pp. 2281–2284.

[17] Volkov A, Chulkov V, Kazaryan R, Sinenko S. Acting adaptation and human parity in the triad "man – knowledge – methods" //Applied Mechanics and Materials. – 2014. –Vols. 584–586. – Pp. 2681–2684.

[18] Kuzina O N, Chulkov V O. Retrivacija – innovacionnoe napravlenie v funkcional'noj sisteme stroitel'nogo pereustrojstva [tekst] // Sb. nauch. tr. IX Mezhdunarodnoj nauchnoprakticheskoj konferencii «Aktual'nye problemy razvitija zhilishhnokommunal'nogo hozjajstva gorodov i naselennyh punktov». – M.: MGAKHiS, 2010. – s. 439–443.

[19] Volkov A A, Chelyshkov P D. Algoritm stsenarnoy verifikatsii inzhenernykh resheniy zdaniy i kompleksov v sistemakh avtomatizatsii proektirovaniya [The algorithm of scenary verification of engineering solutions for buildings and complexes in systems of automatization engineering]. Vestnik MGSU. – MSUCE Bulletin. 2011, No. 5. Pp. 344–347

[20] Chulkov V O, Kazaryan R R, Kuzina O N. [Disorganization as the most important component of the reorganization of functional systems] Promyshlennoe i grazhdanskoe stroitel'stvo. – Industrial and Civil Building. 2009, No. 11. Pp. 58–59.

[21] Chulkov V O, Kuzina O N. Funktsional'noe modelirovanie stroitel'nogo pereustroystva neproizvodstvennykh ob"ektov [Functional Modeling of Redevelopment of Non-industrial Buildings]. Vestnik MGSU [Proceedings of Moscow State University of Civil Engineering]. 2012, no. 9, pp. 251—258.

[22] Volkov A A. Krossplatformennyj intellektual'nyj monitoring i upravlenie resursnoj effektivnost'yu inzhenernykh sistem zdanij [X-plat smart monitoring and control of resiource efficiency of utility system of the buildings]. Stroitel'nye materialy, oborudovanie, tekhnologii XXI v. – Building Materials, Equipment, Technologies of the 20th Century. 2011, No. 5-1. Pp. 34–36.