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# INTEGRATION OF ARTIFICIAL INTELLIGENCE IN THE SUPPLY CHAIN MANAGEMENT

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***Abstract:*** *The suggested research aims to present a short and general overview of the integration of artificial intelligence in the supply chain management.*

***Key words:*** *systematic approach, supply chain management, logistics*

In order to find how the production costs are connected with the revenue, the companies use the so-called gross margin, i.e. the ratio of the net sales, from which the cost of goods sold has been subtracted and after that the difference is divided by the same net sales. The result is multiplied by 100 and this is the percent of the gross margin. In this connection the producer of the telecommunication equipment Infinera Corporation (San Jose, county Santa Clara, the state of California, USA) in 2016 reports a revenue of 870 million dollars which decreases to 740 million dollars in 2017 and the gross margin decreases from 45% to 33%. In 2017 this company reports a net loss of 195 million dollars which shows strong competition, unsuccessful marketing programs, weaknesses in the pricing strategies, divergence in the marketing requirements, ineffective marketing, considerable production costs, etc. After this Infinera Corporation focuses on the fast launching of new products on the market and also it emphasizes on the technological improvements using artificial intelligence in the long term. This is a potential with a number of technologies which combines data, algorithms and calculating power and the technologies aim to aid the employees to focus on the tasks which bring added value and to relieve them from the routine tasks. [7; 10, p. 5; 12; 13, p. 11 – 12; 14; 23].

For the implementation of this strategy, the company Infinera Corporation focuses on the integration of artificial intelligence in the process of supply chain management while using machine learning. This suggests the implementation of systematic approach for integrated management of all the flows by ensuring

informational coordination and synchronization of the basic processes and models of management, on the basis of united informational channels with the suppliers and customers during the whole supply chain. The supply chain is a system of organizations which are included in the process of creation and distribution of the products and services, starting with their creation from raw materials and finishing with their delivery to the end customers. In this relation the system approach for integrated management of all the flows is performed by using algorithms which the devices, machines, software, technologies and services use in order to create mathematical models by quantification as part of the system approach, using example data (numbers, words, images, clicks, and everything which can be stored digitally), called training data in order to forecast or make decisions without being specially trained to do so. The aim of such a management of the supply chains is maximizing the total value, created in the supply chain when forecasting more precisely the dates of the delivery by analyzing past variations in the production periods and presenting the logistic teams. The idea is the sales teams to define as fast as possible the current availability of products for future offers and orders and so the aim is to have the possibility to immediately consider a lot more factors and limitations while making the decisions when creating a specific plan. [7; 11, p. 17, p. 18; 14; 15, p. 13; 22].

The pilot project of Infinera Corporation, connected with the integration of artificial intelligence in the process of the supply chain management was deployed in the middle of 2018 and includes only one production base. The goal is to present information to the sales teams and the clients about the availability of all the products before the end of the year and the use of machine learning would improve the ability of the company to make decisions about the schedules, thus giving it opportunity to rely on more factors than at the moment. In this relation Infinera Corporation uses the technology for supply chain management of Intrigo System, Inc. (Fremont, county Alameda, state of California, USA) in combination with the technology for artificial intelligence of the company Splice Machine (San Francisco, county San Francisco, state of California, USA). The integration of this infrastructure allows Infinera Corporation to receive relevant forecasts from its management systems, as well as to precisely foresee some aspects like the delivery time. By providing real-time information, the sales teams are able to negotiate with the client immediately and regardless of the fact that some goods or services can be unavailable at a certain moment and period, the rest can be negotiated. Forecasting the supplies does not mean only to determine the plans for production and delivery. With the technology of intelligent supply chain management, the company can find reports about past, present or future periods of forwarding different production parts and to combine them with external data sources like weather forecasts for example. [7].

The company Infinera Corporation has an advantage when implementing the chosen technology because it depends on the vertically integrated business model rather than the horizontally integrated one because the first model has better control. In this relation the possibility to invest in highly specialized assets which could create advantages over the competition and these assets would not be of interest to the supplier or customer. Thus, the own production is improved by investments. It is important that the highly specialized assets and the better control over the incoming material flow can bring differentiation from the competition and to obtain competitive advantage. This is a way to increase the market share which could bring increase of the profit. Another possibility to increase the market share is the access to distribution channels and the advantage is that the company distributes the products itself and it decides to whom and how to do this. On the condition that only the company has access to a scarce resource (product or material), the potential competitors would face a serious barrier. In this regard, when the work of the company and the work, performed by the previous suppliers or customers, is included in the organization, the basic competencies of the employees are introduced or enhanced. In this way some of the work places are improved, which increases the satisfaction and motivation of the personnel and this is of great benefit. Besides this, the facts show that over 50% of the communication exchange between business partners continues to be led by fax, email or telephone. Regarding to this, logistics is not the first field which the company management has in mind when they consider the integration of artificial intelligence. In turn, logistics is the part of the supply chain management which controls the effective and efficient forward and reverse movement, production storage and the respective information from the location of storage to the location of consumption in order to satisfy the requirements of the end consumer. Along with this, the research and consultant company Forrester Research, Inc. (Cambridge, county Middlesex, state of Massachusetts, USA), has found out that the use of artificial intelligence for supply chain management is far behind sectors like the marketing, product management, customer support and only 13% state that logistics is a priority sphere for integration of systems with artificial intelligence. It should be noted that the supply chain usually includes a large number of external partners, some of which can be technologically behind the others. Often there are problems with the operational compatibility and the quality of the data which is basically a characteristic, showing the degree of possibility for their analysis, and also that they satisfy the requirements of the concerned parties in the business. So before applying sophisticated algorithms for analysis and machine learning to the data from the supply chains, the companies should collect this data from its producers, distributors, suppliers, etc. This is the biggest challenge, together with the fact that after the data is processed, it cannot be always used immediately and the companies are trying to

solve this problem. [1, p. 167; 4, p. 90; 5, p. 127; 6; 7; 15, p. 32 – 33, p. 48 – 49; 16, p. 14 (note 8); 18, p. 102 – 103, p. 146; 19].

The analysis of the data and the forecasting of different aspects, related to the logistics, technologies, based on artificial intelligence, are used in other points in the supply chain management. In this relation, the personal assistants like Siri (developed by the corporation Apple Inc.), Alexa (a technology, developed by the company Amazon.com, Inc.) and Google (developed by the corporation Google, Inc.) exist for the consumers of the artificial intelligence. They combine voice recognition and processing of natural language and all of them are based on artificial intelligence. Such an approach can be used for creating virtual agents which could aid the companies to obtain information from the information systems for organization management. In this relation image recognition is another aspect in which artificial intelligence is widely applied and this is of great significance for the stock management. This is the practice of the chain store Amazon Go (owned by Amazon.com, Inc.) and they tested a robot with a stethoscope camera for keeping the inventory. A similar pilot project has been started by the chain store Walmart, Inc. Another sphere where artificial intelligence would be helpful is pricing. This includes price optimization and automatization of the pricing and the technology can improve human productivity, i.e. the combination of human intelligence, artificial intelligence and automation saves time, decreases the operational expenses and prevents mistakes which are made by manual processing. Thus, relying on artificial intelligence, the employees will not perform routine activities but they will analyze and foster creativity. [7].

In its essence artificial intelligence is a transforming business technology which, in combination with the Internet of things, gives the companies an autonomous supply chain which can transform in the future into a self-aware, self-managed and self-defining system. In turn, the Internet of things refers to providing, connecting and integrating a large number of various technologies, devices, machines, software and services, not only computers and smartphones, into a united network, which allows them to be observed and/or controlled distantly. The company ABB, Inc. (Zurich, canton of Zurich, Confederation Switzerland) is trying to do this by developing research centers which work on the implementation of artificial intelligence and machine learning. A research of the company has shown that the customers' interests are connected with condition monitoring and anticipatory maintenance, i.e. when there is a possibility of a problem and how long they can rely on a specific asset. The above said suggests that the results from the monitoring and their analysis give the ability to control the time and cost of the process and also to balance the resources. If something is known to be going out of order, this should be noted in the system to be ordered, for example spare parts. In turn, in the process of anticipatory maintenance the components of the industrial equipment are

repaired or changed before failure and thus expensive subsequent operations are avoided. [2; 3, p. 63; 7; 8; 9; 17; 20, p. 212; 21].

**References:**


[1]. Botev, B. Genov G., Botev R. Technical Logistics, Shumen, 2015, University Press Episkop Konstantin Preslavski

[2]. Bosch increases its competitiveness with Industry 4.0 „– Auto-press.net, Official importers: news, Sofia, (Jun 24, 2016), Autopress 2001 Ltd., <https://www.auto-press.net>

[3]. Vasilev D., Designing of Internet of Things, (IoT). – MATTEX 2020, Conference proceedings, Vol. 2, Shumen, 2020, University Press Episkop Konstantin Preslavski, 63 – 67.

[4]. Vasileva B., Marketing. A Practical Guide. Varna, 2012, Publishing House eM Studio Advertising and Creative. Василева, Б. Маркетинг. Практическо ръководство.

[5]. Goranova P., The Vertical Marketing Systems and the tendencies in their development, International Scientific Conference Economic Wellbeing through Knowledge Sharing, Svishtov, 2016, AP Tsenov, <https://dlib.uni-svishtov.bg/handle/10610/2907/recent-submissions?offset=60>, 04.05.2021.

[6]. 5.1.2 Why to choose vertical integration? Advantages and disadvantages – Strategy-Train, Small Enterprise Strategic Development Training [1. November 2008 – 31. October 2010 (24 months)], Graz, Austria, (AT), Multidisciplinary European Research Institute Graz, <http://st.merig.eu/index.php?id=138&L=3>, 04.05.2021.

[7]. Artificial intelligence in the supply chain – CIO.bg, Management, CIO Media, 03 May 2018, Sofia, ICT Media, <https://cio.bg/management/2018/05/03/3433148_izkustveniiat_intelekt_vuv_verigata_za_dostavki/>, 03.05.2021.

[8]. The anticipatory maintenance – one of the biggest gifts of the industrial IoT – CIO.bg, Cloud Technologies, CIO Media, 15 March 2018, Sofia, ICT Media, <https://cio.bg/oblachni_tehnologii/2018/03/15/3433438_izprevarvashtata_poddrujka_edin_ot_nai-golemite_darove/>, 06.05.2021.

[9]. Internet of Things – importance and application in the contemporary dynamic world of technologies – ДигиталнаИндустрия.bg, 3D Technologies/IoT, 04 January 2018, <https://xn--80aahddubcb0awc4bnhip4t.bg/tema/oblachni-uslugi-iot/internet-neshtata-znachenie-prilozhenie-savremenniya-dinamichen>, 06.05.2021.

[10]. Concept for the development of artificial intelligence in Bulgaria until 2030 Artificial intelligence for growth and prosperous democratic society. Sofia, 2020, (October 2020), Council of Ministers (Approved with Record №72

from the Meeting of the Council of Ministers on 16.12.2020), <https://www.mtitc.government.bg/bg/category/157/koncepciya-za-razvitieto-na-izkustveniya-intelekt-v-bulgariya-do-2030-g>, 05.05.2021.
[11]. Koraliev, Y. Supply chain management, Sofia 2013, Publishing Complex – UNWE.
[12]. Myths about industry 4.0“. – CIO.bg, Software, CIO Media, 27 Април 2018, София, ICT Media, <https://cio.bg/softuer/2018/04/27/3433159_mitovete_za_industriia_40>, 05.05.2021.
[13]. Nisheva M., D. Shishkov, Artificial Intelligence. Dobrich, 1995, Publishing House Integral.
[14]. On the way to the future – the new technologies – Engineering Review 15.07.2019, <https://www.engineering-review.bg/bg/po-patya-kam-badeshteto-novite-tehnologii/2/4130/>; 12.05.2021.
[15]. Rakovska M., Supply chain management. Sofia, 2013, Publishing Complex UNWE.
[16]. Rakovska M., N. Dragomirov, K. Lukanov, Business logistics. Sofia, 2018, Publishing Complex UNWE.
[17]. Stoyanov R., I. Popchev, Internet of Things – ResearchGate, February 2017, 1 – 15 <https://www.researchgate.net/publication/322953157_Internet_na_nesata>, 06.05.2021.
[18]. Terziev V., V. Banabakova, Marketing, Skopie 2017, NIMZ.
[19]. Tuzharov H., Quality of the data. – Data management, 2013, <http://tuj.asenevtsi.com/Data/IndexD.htm>, 06.05.2021.
[20]. Antonov, A., Yankova-Yordanova, Y., Mihailova, R. Structural-methodical complex for training with AnyLogic (First stage). – MATTEX 2016, Conference proceedings, Volume 2, Bulgaria, Shumen, 2016, 209 – 212, Konstantin Preslavski university press.
[21]. Business Process Management – instruments for establishing order in business. – CIO.bg, Projects, CIO Media, 18 February 2018, Sofia, ICT Media, <https://cio.bg/proekti/2013/02/18/3443621_bpm_instrumenti_za_vuvejdane_na_red_v_biznesa/>, 06.05.2021.
[22]. „Machine Learning – what do we know about it. – Divna-Tech, 01 December 2019, <https://divna.tech/machine-learning/>, 05.05.2021.
[23]. Reddigari, M. How to calculate profit margin. – Microsoft, 03 June 2019, <https://www.microsoft.com/bg-bg/microsoft-365/business-insights-ideas/resources/how-to-calculate-profit-margin>, 11.05.2021.