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## **ЦЕПИ СНАБЖЕНИЯ - ВИЗУАЛИЗАЦИЯ И ИОТ SUPPLY CHAINS - VISUALIZATION AND IIOT**

**Аннотация.** В данной статье рассмотрен вопрос управления цепочками поставок посредством использования современных цифровых технологий, базирующихся на автоматизации обмена данными в интралогистических процессах и цепочках поставок с использованием различных, как существующих, так и новых технологий, которые следуют за физическими операциями и процессами, создавая в реальном времени виртуальные копии физического рынка и децентрализованных решений. Основная идея, заложенная в данной работе, заключается в интеграции информационных технологий, которые используются для компьютерной обработки данных и информации, с операционными технологическими системами, используемыми для мониторинга событий, процессов и средств работы и их адаптации в деловых и промышленных операциях и процессах. Целью работы является выявление необходимости визуализации, возможных технологий обработки данных, базовой конфигурации такой системы, а также определение направления дальнейшего развития информационных технологий в цепочках поставок

**Ключевые слова:** цепочка поставок, Интернет вещей, промышленный Интернет, технология обработки, визуализация.

**Abstract.** Supply chain digital management is the current trend of automation in data sharing in intralogistics processes and supply chains, using a variety of existing and new technologies that follow physical operations and processes, creating virtual copies of the physical market and decentralized decisions, all in the real time. The main idea is the integration of information technology, which is used for computer data processing and information, with the operational technology systems used to monitor events, processes, and means of work and their adaptation in business and industrial operations and processes. The aim of the paper is to point out the need for a visualization, possible data processing technologies, basic configuration of such a system, and the direction of further development of information technology in supply chains.

**Keywords:** supply chain, Internet of things, industrial Internet stuff, processing technology, visualization

### **SUPPLY CHAINS**

Supply chains (SC) include very complex technological processes, in which the work of different participants needs to be connected and coordinated with different information systems, different means of transport by means of transport, different technological requirements, etc. Using the Industrial Internet of Things (IIoT) technology, the means of work that are physically distant and unconnected, communicate under the machine-to-machine (M2M) model, and exchange data online to improve the process of their use. Many machines that are being tracked or tuned are not computerized, and in connection with computers, they mainly use closed protocols and programmable logic controllers (PLCs), and not technologies that provide complete control over the computer. By integrating participants and monitoring their work, large databases are creating. They are too large for any analysis by traditional methods and can only be used with the Big Data technologies. There is also the problem of keeping such amount of data.

Nowadays, the concept of computerized management is gaining in importance, and the interaction is directed to the collection, storage, analysis, exchange and visualization of all forms of electronic data. This is done in different ways, and in some cases using machine learning and artificial intelligence. More and more, sensors and related systems, as wireless sensors' and actuators' networks (VSAN) are integrated into the management of industrial environments, such as those for water treatment, production and distribution of electrical energy, and automation of processes in factories.

Integration of automation, communication, and networking in industrial environments is an integral part of the growing IIoT.

More and more in the supply chains is talked about the Blockchain, as a new technology, which can be used to manage global trade, and in particular in supply chains, including providing regulatory assistance and product testing, compiling and sending of dispatch orders or the cargo bills of lading, negotiation of letters of credit, licensing and / or improvement of the integrity of transactions, increasing the quality of financial control and improving operational efficiency, etc.

#### NEED FOR SUPPLY CHAIN VISUALIZATION

With the advent of new information technologies, new requirements are also raised by SC participants in terms of data collection and visualization in all phases of SC implementation, to allow automatic planning and management of each SC state. Fundamental changes are required because of:

- Possessing of detailed analyses of each customer transaction, which would determine the causes of demand, better forecasts of future sales, with detailed demand plans,
- Knowing many of supplier characteristics such as the delivery probability, order scheduling and disposition, supplier capacity constraints, time variability, current and future stock terms, order limits, etc.
- Optimum stock status especially in the omnichannel environment,
- Formation of reliable and defined analytics with clear procedures and messages in the execution of specific requests and tasks, both individually and team, for the complete elimination of omissions in work,
- Ability to generate extremely accurate forecasts, precise plans of demand and supply, efficient and simple execution of the process,
- Full visibility of internal and external processes,
- Easy aggregation, separation, and management of demand and supply at any level,
- Simulating the effects of different services, money, and goals, and then re-planning in terms of achieving the optimal goals of their organizations,
- Application of new trends, new conditions of risk and market disturbance,
- etc.

To fulfill the previous requirements, a systematized and reliable database based on data obtained from the IIoT is needed.

Possible application of IIoT is located in factory lines for monitoring the operation of production equipment, in warehouses and terminals (RFID and NFC tags), monitoring of cargo and quality during transport and throughout the SC, and on shelves in retail, connection of logistical operations, Smart Surveillance and Smart Networking, Smart City Applications, Industrial Safety Systems Control, Energy Optimization, Industrial Heating, Ventilation and Air Conditioning, Property Monitoring and Smart Logistics, Environmental Monitoring (Ozone, Gas and Temperature in Industrial environment), monitoring the safety and working conditions of workers, managing process and system performance, and so on.

Digitization is an important key to better understanding the customer and accurately predicting future needs.

#### ECONOMIC ASPECTS OF THE NEED FOR VISUALIZATION AND IIoT

According to [1], aspects of the improvement of traditional SCs have been studied, where most of the 366 surveyed organizations cite the basic aspects of possible improvements through shortening delivery times (51%), reducing inventory costs (50%), better inventory optimization (43%), the efficiency of SC (42%), the creation of a more flexible SC (35%), focusing on customer (35%), the visibility of the process (34%), the influence of the SC on the profit growth (29%), the improvement of procedures (27%), shorter production cycles (23%), ability to adjust products and services (12%), procedures of job completion (12%). Reducing of delivery times, cost reduction, and inventory optimization is often cited as critical aspects of SC operations that organizations need to improve. Upgrading overall SC efficiency and creating chains with greater flexibility are also major

priorities. More precisely, manufacturers and freight forwarders are looking to improve inventory management capabilities, initiatives related to improving visibility, and communication with suppliers and customers. With the visibility of the location and condition of goods in the SC, opportunities for significant cost reduction, greater efficiency, and improved service quality are created.

According to [2], aspects of the improvement of traditional SCs have been studied, where most of the 210 surveyed respondents shared their input on the key supply chain performance challenges that they are facing, operational areas that are in need of improvement, and the software solutions being used to overcome critical supply chain issues: increasing supply chain efficiencies (67%), Greater control over supply chain costs (63%), Inventory optimization and reduction of on-hand inventory (61%), Optimizing transportation logistics (activities (mode, route, weight, 58%), Greater customer satisfaction (56%), Sourcing and supplier relationship management (47%) and others. All supply chain activities are centralized under a supply chain officer 35%, each business unit controls their own supply chain decisions 27%, centralized management but decision-making is on a local business unit level 24% No formal structure 11%, other 3%.

The Internet radically changed the world of communication. More than 24% of the world's organizations believe that the IIoT will transform and improve their business [3]. The effects of SC visualization are different. The IIoT SC will enable the collection of data and information on the process, on the means of work, etc. For example, in production, IIoT applications can detect potential problems within the machine before the machine falls into operation, which will allow greater accuracy and identification of potential problems during the process of monitoring the temperature, oil pressure, wear, etc. In addition, IoT can identify the exact cause of the problem and provide detailed instructions on how to perform the repair, to provide the specification of the parts to be replaced, the tools necessary for the repair, and instructions if maintenance workers have no previous experience in replacing this worn out part. Similarly, IIoT can ensure maintenance of machine functionality during operation, preventing interruptions and predicting when maintenance is required.

During the distribution, more problems can arise, such as delays and inefficiencies. Using the IIoT in SC, it is possible to redirect the vehicle's operation by giving new directions to the driver of a road vehicle, making changes in automated delivery systems, or facilitating new delivery methods, via unmanned aircraft vehicles, drones. By identifying inefficiencies and problems before they occur, the total cost of the supply chain can be reduced. Moreover, the use of robotics in the fulfillment of requirements and tasks, in the process of "selecting goods" in warehouses, can contribute to shorter delivery times. As a result, the organization will probably grow faster and expand its customer base. The great importance of IIoT will be in retail in inventory management, sales promotion, object theft, product quality and so on.

Using of information technology in more than 110 countries of the world, automated circulation of information is enabled. According to Gartner, projected 20 billion "things" connected online to the year 2020, will give more data than we've ever had before, and the speed of business is traveling faster than we can keep up. IDC estimates that by 2020, business transactions on the Internet, business-to-business and business-to-consumer, will reach 450 billion per day. More than 50 billion sensors will be interacting with each other. It's also predicted that data production will be 44 times greater in 2020 than it was in 2009. [4]

When a customer forms an order, the IIoT delivery chain can allow the automatic transfer of information from the buyer to the seller and vice versa. In the future, the IIoT will allow at the points of sale to recognize the change in inventory status and delivery of goods, to generate payment to the appropriate supplier, to oversee supplies, etc. If this simple example will be expanded to other activities, the IIoT SC capabilities in daily operations can become infinite. Hospitals, pharmacies, and drugstores would automatically set new delivery requirements before existing supplies become insufficient, which would improve patient's satisfaction and encourage better health care.

More and more it is written about the use of robots (Internet of Robotic Things - IoRT) in supply chains where intelligent means can monitor events through sensors from different sources using local and "distributed" intelligence to determine the best workflow while simultaneously

controlling and handling resources in the physical sense as they move through the infrastructure objects. This achieves the integration of workflows, real-time update of the situation, and the ability to obtain pervasive analytics, which maximizes the revenue of the organization. With the use of IIoT, in most cases in SC, human intervention as input will be almost eliminated.

Although not analyzed in this paper, one should never lose sight of the potential risks that can arise from the application of new technologies. About such a problem it was written in many sources including [5-9]. Will there be hacker's attacks, abuses, drops of drones, etc.? Yes!

## CONCLUSIONS

One of the biggest advantages of IIoT SC is its ability to quickly collect, monitor and analyze data. That allows to automatically detect the current situation, trends that become more important, and the ability to improve business. The IIoT has changed, changed, and will continue to change the world, especially in SC processes. Visualization of data can be applied to any SC process that provides users with information that enables the current management of operations, quick information exchange and faster decision making, which certainly can reduce the delivery time.

SC managers will focus on increasing the delivery timeliness, with additional pressure on employees, drivers and other individuals in the SC to increase the quality of service in terms of delivery at the right place, at the right time, in the proper condition, in the right package, with proper documentation, to the right buyer, and in the requested quantity. SC will dominate the market when purchasing new products and spare parts. It is to expect that SC management will finally receive a standard certification process. Now there are many different platforms and services available, with almost every system different, which needs to be integrated through IIoT. The certified process will help to encourage efficient and effective deployment and use of new systems and services while reducing the existing skills shortage.

The visibility will become a special category in SC technology that is covered by analysts. Over the last two decades, visibility has been covered by different categories and software (ERP, TMS, WMS, GTM, SCP, S & OP, SCE) and now Supply Chain Visibility (SCV). However, with the rapid development of information technology and the growing number of indicators and performance required by SC participants, conditions are created for increasing operational potentials tailored to specific situations [10].

Blockchain will continue to develop, although it is currently, away from any mass adoption in the SC. The development of new devices and mobile capabilities will become easier in the SC. Plenty of information delivered in real time will ultimately allow solving more problems than they really exist. In the world, organizations increasingly submit their requests for proposal (RFP), i.e. requests for business proposal submission by their customers in terms of implementation of digitization and improved visibility.

In the end, does this computerized future bring also safety risks? Yes!

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