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## GRAPH-MODELING WHEN THE RESPONSE AND RECOVERY OF AGRICULTURAL MACHINERY

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The material world is combined with virtual and generates new approaches and business models [1]. Manufacturers earn more and invest in improving the quality of products and services [2].



The term "industry 4.0" appeared in Europe in 2011. At one of the industrial exhibitions in Hannover, the German government spoke about the need for broader use of information technologies in production [3]. A specially created group of officials and professionals developed a strategy for the transformation of production enterprises of the country into "smart" [4].

This example was followed by other countries that are actively mastering new technologies [5]. And the term "industry 4.0" began to be used as a synonym for the fourth industrial revolution [6]. Its essence is that the material world today merges with virtual, resulting in new cyberphysical complexes that are combined into a single digital ecosystem [7]. Robotted production and "smart" factories are one of the components of the transformed industry [8].

The fourth industrial revolution means increasing automation of all processes and stages of production: from digital design of the product, creating its virtual copy -

to remote setting of equipment at the plant in accordance with the technical requirements for the production of this specific "smart" product [9]. The manufacturer automatically orders the required components in the right amount, controls their delivery, has the opportunity to track the path of the finished product from the warehouse at the factory and store to the end client. But even after the sale, the company does not forget about its product, as it was in the classic model, and controls the conditions of its use, can remotely change the settings, update the software, warn the client about a possible malfunction, and at the end of the cycle of use - to accept the product for utilization [10].

Yes, they are now produced from "smart" teapots and frying pans to smartphones. Last year, Apple launched a program of processing old iPhones: the works dismantle them, remove the most valuable details, which are then used again, and everything else is disposed of, and with the minimum damage to the environment. The concept of "Industry 4.0" is often depicted in the form of a mathematical sign of infinity - it illustrates this endless cycle of interaction of the manufacturer with the product and the client [11].

Principles of industry construction 4.0. The Germans formulated several basic principles for the construction of "Industry 4.0", in compliance with which companies can implement scenarios of the fourth industrial revolution at their enterprises [12].

The first is compatibility, which means the ability of machines, devices, sensors and people to interact with each other through the Internet of Things (IOT) [13].

This leads to the following principle - transparency that appears as a result of such interaction. The virtual world creates a digital copy of real objects, systems, functions that exactly repeats everything that happens to its physical clone. As a result, the most comprehensive information about all the processes that occur with the equipment, "smart" products, production as a whole and so on. To do this, it is necessary to collect all these data from sensors and sensors, as well as from accounting for the context in which they are generated.

Technical support is the third principle of "Industry 4.0". Computer systems help people make decisions through the collection, analysis and visualization of all the information mentioned above. This support can also be a full replacement of people with cars when performing dangerous or routine operations.

The fourth principle is the detailing of management decisions, the delegation of some of them cyberphysical systems. The idea is that the automation is as complete as it is possible: everywhere where the car can work effectively without people's intervention, sooner or later there should be a person's replacement. Employees are given the role of controllers who can join in emergency situations.

The transition of industry to these principles also changes in business models. So, instead of focusing on a savings production, companies seek to introduce a personalized mass product on the principle of Agile and switch to the issue of batches in size into a single product. This retains the principle of savings: robotic production is more energy efficient, it is accompanied by less waste and marriage.

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The transformation of the production industry is called a revolution precisely because changes are not surface but radical: the industry is restructured from below. Business models are changing, new companies are being born, and worldwide-famous brands with a long history simply disappear if they do not have time to join the ranks of digital revolutionaries. Customers have changed their behavior, they want an individual approach and unique goods. Representatives of the generation of the so -called Native Digital, who grew up in the Internet, are accustomed to the fact that they have opened a whole world of offers: millions of options for T -shirt prints, all shades of jeans, whatever technique and furniture at a distance of one click. They try to emphasize their individual characteristics and express your mood.

Enterprises that are used to producing the same things have to change. The implementation of the 4.0 industry principles allows you to get a number of benefits that have not been available in traditional models of the past. For example, companies can now reach an individual approach and personalize orders according to the personal preference of customers, which rapidly increases their loyalty. Old factories and factories turn into "smart" and begin to produce literally unique products on individual order. This reduces the specific cost of production of a unit of production, companies are able to produce a unique personalized product at the price of a mass standardized product.



For example, today you can, sitting in a cafe on Khreschatyk, download Nike or go to the company's website, choose a model of sneakers, paint them with colors of your favorite football team, pay a purchase and get it in a few weeks. And it will cost \$ 120, not taking into account the cost of delivery - no more expensive than the usual non -personalized sneakers of the same company. The manufacturer gets the opportunity to offer customers more unique options for their product, which becomes an additional source of profit and increases the margin of business.

Individual orders can produce both engines, servers, and anything. At the Fujitsu Siemens plant in the German city of Augsburg, computer systems and servers are literally available in one copy for a particular customer.



The cost of producing products on an individual order at an enterprise with a high level of automation is small: if earlier, for each such a couple of sneakers, you would have to handle the equipment manually, now the computer system does it in a few seconds. Tesla plants that produce electric vehicles allowed the company to deploy production not in China but in California. This was cheaper than paying for the work of Chinese workers and transporting ready -made machines. Not only does the fourth industrial revolution change the business of individual companies - it influences the placement of forces at the global level. Who would have thought that the manufacturer of cars that was not ten years old (Tesla was founded in 2008) will be able to overtake the capitalization of the leader of the Second Industrial Revolution, which took place as a result of the invention of the conveyor and the transition to mass production, Ford Motors.

Thanks to new technologies, another well-known manufacturer, Adidas, transferred its production back to Germany. At the new factory, all operations will perform work. It not only optimizes production, but also significantly increases speed.

Resources for change. Not all companies with a long history will experience this wave of digital transformation. 52% of Fortune 500 rating companies in 2000 no longer exist today. But those who can transform will have twice as much winnings: consumers are loyal to the brands they respect and are ready to stay with them if they go to individual format. For example, Harley-Davidson's stocks, after transformation of business in partnership and through the implementation of industry principles 4.0, have increased 7 times in six years. And this is despite the fact that the company has experienced a serious fall in demand for its products due to the economic crisis. You can now order your personal model of the legendary Harley in your favorite colors and get it from the factory within 6 hours.

BrP-Rotax production company was able to establish the production of personalized motors for lightweight aircraft, snowmobiles and karting vehicles. The loyalty of customers who can now receive engines according to their own preferences and for specific needs has grown significantly-as well as BRP-Rotax sales.

The transition to "smart" production, of course, is not so easy. If the company uses an outdated ERP system, it may be a "narrow place" in the implementation of industry principles 4.0. If an individual configuration is required for the production of tens of thousands of finished products, then the volume of data is increasing by several points, and only the information is able to maintain so much information is capable of maintaining so much information. Such as, for example, SAP S/4HANA-new generation ERP system, corporate solution for enterprise resources management.

The system is designed to take into account the latest technologies: support of the Internet of things, machine learning, processing of large volumes of data in RAM. She is able to solve problems that, because of the lack of technology development and unjustifiably high costs of human resources, was difficult to implement.

For example, one of the SAP customers produces one engine every eight seconds on three production lines. In such a complex production, ten thousand material transactions per minute must be performed for the individual order of the client. Thanks to the use of S/4HANA, the company produces the writing off of components in real time without the need for batch processing at the end of each change. This allows every moment to have up-to-date information about the remains of inventory. The system supports the functionality of accurate production planning and the ability to maximize the planning of the logistics network on single basic data and in one system. This significantly increases the accuracy and promptness of planning.

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Considering the issues of preparation for harvesting grain crops, it should be noted that life persistently indicates the need to solve it in a comprehensive way, namely: with the use of modern, advanced technologies of pre-field training of machines and the latest knowledge of maintenance and repair of machines in the agricultural farms of our country.

Nowadays, the method of repair and service works for refusal is increasingly promoted from the experience of Western countries. In the presence of a wide network of dealership and service regional centers, the implementation of this method can be justified for a wide reservation of basic machines in farms. In the conditions of modern management in our country, the use of the method of repair and maintenance for refusal is unjustified and can lead to catastrophic consequences. The late supply of the necessary spare parts, units and units to the farm will cause simple machines and combines during grain harvesting and loss of crops. Earlier in our country, the planned and service system of repair and maintenance works is the most favorable and most effective. It allows you to put on a line of readiness of grain harvesting equipment and carry out harvesting of cereals without failures - within certain agrotechnical terms. To do this, first of all, it is necessary to put into operation the machines that were used in the harvesting of the harvest last year or written off. It is known that the complex of the main machines for harvesting cereals includes the following: grain harvesters "Lan"; foreign production John Deere; Claas; Case New Holland, etc., as well as vehicles (tractors with trailers and cars) and loads. The state of affairs, which has developed with the preparation of grain harvesting equipment for carrying out harvesting work in many farms, requires from the mechanics of taking urgent measures to accelerate the pace of repair and service work. Further improvement and improvement requires the organization of maintenance of machine-tractor park, as well as performing repair and maintenance work before setting equipment on a line of readiness. An important condition for the preparation of grain harvesting machines for the season is preparation, first of all, a hammer.

The main part of each combine is a threshing unit, the capacity of which depends on the efficiency of the machine. The main defects of the combine threshing drum are: the bitchying, the deformation of the shaft, the violation of balancing, and sometimes the violation of the integrity of the drum. The increase in the threshing unit is mostly affected by the condition of the drum, the bearing units and the dynamic unbalance of the drum itself. During the repair of the threshing unit, a special stand is used, which is equipped with pneumatic and hydraulic tools.

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**МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ  
НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ БІОРЕСУРСІВ І  
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В збірнику представлені тези доповідей науково-педагогічних працівників, наукових співробітників, аспірантів та студентів НУБіП України, провідних вітчизняних і закордонних вищих навчальних закладів та наукових установ, в яких розглядаються завершені етапи розробок.

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