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Составители:
Хоменко С.А., Личевская С.П.

Р е ц е н з е н т
Заведующий кафедрой английского языка естественных факультетов ФСК БГУ, кандидат филологических наук, доцент А.Э. Черенда

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Белорусский национальный технический университет.
Факультет горного дела и инженерной экологии.
Пр-т Независимости, 65, уч. корп. 9, г. Минск, Республика Беларусь.
Тел.: (017) 331-40-52
E-mail: eng1@tut.by
http://www.bntu.by/fgde.html

Содержание

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Dubinko O., Khomenko S.

Innovative Supply Chain and Logistics Technology Trends

Belarusian National Technical University
Minsk, Belarus

In the modern era, the technology boom and the complexity of logistics processes have spawned logistics management software and specialized logistics-focused firms that expedite the movement of resources along the supply chain. Manufacturing companies may choose to outsource the management of their logistics to specialists or manage logistics internally if it is cost-effective to do so [1].

The logistics industry trends are dependent on significant changes that are driven by the implementation of technology-driven innovations in the business processes. The next-generation logistics management solutions are moving towards making the global supply chains more customer-centric and sustainable. Automation in logistics processes brings out a significant increase in productivity and efficiency in the workflow [2]. The improvement of transparency and traceability of the supply chain is vital to maintain a flexible and dynamic relationship between various stakeholders.

Increasing technology innovations are making big waves across industries, and logistics and the supply chain may be one of the most impacted sectors. Notorious for its heavy use of manual processes and large amounts of data stored in different ways and in different places, the logistics industry has perhaps the most to gain from implementing new technologies and following the most innovative Supply Chain and Logistics technology trends.

Recent years have seen massive advancement for the logistics industry in areas like artificial and augmented intelligence, advanced analytics, and automation, to name just a few. These technologies have evolved faster than ever while startups with even newer solutions and innovations continue popping up at a rapid rate. But attached to these innovations are new expectations and standards, forcing logistics companies to either adapt or fall behind. Much pressure comes from customers in the form of individuals and enterprises, all of them are demanding their products or services come faster and cheaper than ever before.

Over the past several years, the logistics industry has started to integrate Artificial Intelligence (AI) solutions including intelligent transportation, route planning, and demand planning in their operations — but this is only just the beginning. From last-mile delivery robots and sustainability solutions, to warehouse automated picking systems and predictive optimization software, AI is already making a huge difference in logistics [3].

This can be seen in a number of logistics applications. While trucking, rail and ocean freight have been tracked by satellite via telematics for decades, and versions of electronic driver logs have been around for nearly 20 years, the data has not been properly utilized until now. Previous tracking efforts did not provide «clean» data and had been regularly stored on paper, making proper analysis more difficult. The difference today, however, is not only the presence of more data but also vastly more powerful computing and algorithms to sort, evaluate and result in action. Along with AI, Augmented Intelligence is also expected to spike in use. Augmented intelligence combines human intelligence with AI automated processes.

Three driving trends are paving the way for AI’s current boom: cheaper, better computing power, the ever-increasing

usability of Big Data, and improved algorithms [4]. These forces continue to culminate in more powerful AI applications, providing present and future applications which intrinsically alter what is possible in logistics. Much like the agricultural revolution, the digital revolution is impacting many different aspects of modern life – and logistics is one of the industries primed for disruption. It is beginning its journey to become an AI-driven industry – but the future remains rife with challenges to overcome and opportunities to realize.

Digital twins are possibly one of the most exciting logistics technology trends to keep an eye on. As many logistics professionals know, products are never exactly the same as their computer models. Modeling in its current state doesn't take into account how parts wear out and are replaced, how fatigue accumulates in structures, or how owners make modifications to suit their changing needs. However, digital twins technology is changing this once and for all. Now, physical and digital worlds can be melded into one, thus allowing us for the first time to engage with the digital model of a physical object or part just like we would with their physical counterparts.

The potential use cases for digital twins in logistics are vast. In the shipment sector, digital twins can be used to collect product and packaging data and use that information to identify potential weaknesses and recurring trends to improve future operations. Warehouses and facilities can also use the technology to create accurate 3D models of their centers and experiment with layout changes or the introduction of new equipment to see their impact, risk-free. Furthermore, logistics hubs are able to create digital twins and use those to test out different scenarios and increase efficiency. In addition to that, delivery networks could use the technology to provide real-time information that will improve delivery times and further aid autonomous vehicles in their routes. It will be interesting to

see what other impactful logistics use cases develop over the next year [5].

One can't speak about supply chain visibility without also mentioning IoT (Internet of Things) sensor technology, a crucial asset for tracking shipments. Connected IoT devices on parcels allow warehouses to track inventory, vehicles, and equipment through cloud services. At the same time, the container management powered by IoT also becomes easier through real-time monitoring, increasing fuel efficiency, implementing preventative maintenance and making container operations proactive instead of reactive.

Since its advent in 2008, blockchain has grown to become one of the biggest buzzwords in any industry as well as one of the most overhyped logistics technology trends [6]. However, the complicated concept of the blockchain has been difficult to grasp for the general public, and despite its strong potential for incredible use cases both in and outside of the logistics, there's been an overall lack of real development. This has led blockchain to become extremely overhyped and logistics professionals to feel fatigued from the term's overuse.

But it's not just new technology shaping the future of logistics. It's also emerging business models and new industry players. Often driven by startups, new systems incorporating elements of the sharing economy are gaining prominence fast. Without the need for a rich asset background, startups tend to focus on the «asset-light» parts of the value chain, for example by turning into digital freight forwarders.

With more flexible operations, they can offer more agile pricing and provide quotes faster, while championing transparency [7]. This is the case for Uber, which launched its Uber Freight feature in the US in 2017 and has expanded to Europe and Canada this year in pursuit of a more effective global freight marketplace. Amazon has also announced its

new robotics products heading to its hundreds of fulfillment centers around the world.

Sustainability is a trend that has been cutting across industries and logistics is no exception. Last-mile delivery, in particular, is traditionally a very time- and energy-consuming, which is also why it presents many opportunities for fresh and smart approaches. To lessen the negative environmental impact, companies leverage a plethora of technologies, from actual electric vehicles to AI-based software that calculates the route with the lowest generated emissions.

Similar logistics technology trends can be seen across the entire shipping sector. Just recently, over 60 commercial groups, including Maersk, launched an initiative that aims to use ships and marine fuels with zero carbon emissions on the high seas by 2030. These efforts are fundamental not only due to their direct impact but because they inspire the whole industry to adopt a more sustainable mindset. Even though autonomous vehicles, be it trucks or drones, have become closely associated with the close future of logistics, we are still likely to see it in only its trial stage throughout the next year [8].

Whether it's wearable technology, driverless vehicles, or multifunctional robots, robotization can significantly improve the efficiency and speed of warehouse processes. With machine-learning technologies and sensors ensuring extreme accuracy and easy traceability, the modern warehouse will start seeing the inclusion of many more autonomous robots.

Just a few short decades ago, it was nearly unimaginable that we could ever turn vast amounts of data into actionable information for logistics providers around the globe. But fast forward to today, and data has become the cornerstone of any modern logistics operation. Improved operational efficiency, last-mile and real-time route optimization, strategic network and capacity planning, customer service improvement and

more product innovation are just a few of the major benefits now easily produced by a data-driven business [9].

There are both pros and cons that come with this access to massive quantities of information. While this data has the potential to inspire exciting business transformation, it's often more difficult for logistics organizations to sort through it to discern what's useful and what's not. If your company has piles of data in various formats and systems which aren't being used to create actionable insights, its storage will only become useful when a data-driven solution is implemented later on. This is why many organizations are starting to rely on industry data standards, which dictate how data should be recorded, stored, and shared. Standards may vary by industry, but the governing principle is that any crucial information must be exchanged in a common format that makes collaborating and extracting insights simple and straightforward.

Unfortunately, across the industry, logistics data standards have yet to become a common practice. The lack of industry data standards complicates the exchange of information, which in turn limits innovation by providing an incomplete picture of issues that may be affecting logistics companies. For example, maritime freight shippers have cited a lack of common data standards as a major industry problem, making it more difficult to conduct business between carriers. Container shippers have also recognized the need for standardization in their industry.

Despite the best efforts of data standardization organizations, a great deal of work remains to be done. Fortunately, because data standardization already plays a significant role in nearly every other major industry, it seems inevitable that logistics providers will eventually agree on a set of universal data standards. The opportunities presented by AI, blockchain, and IoT are simply too valuable to pass up, and while the path to widespread adoption may be challenging, it's

certainly a problem worth solving in order to deliver next-generation insights and performance.

Once companies have good quality standardized data, it unlocks all kinds of opportunities for predictive optimization in logistics to achieve much higher levels of operational efficiency. With that in mind, Logistics providers seeking greater efficiency and collaboration should continue taking small steps of their own to embrace data standards and build an industry more powerful than ever before.

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Novikova A., Khomenko S.

Features of Project Development for Business Process Automation

Belarusian National Technical University
Minsk, Belarus

Since we live in the «information age», information technology (IT) has become a part of our daily lives. Technology allows us to share information with our friends, family and others. In addition, technology can help us in our daily life.

Technology, which brings together tools to promote development, use and information exchange, has as its main objective of making tasks easier and the solving of many problems of mankind. The development of new technologies helps to save lives; it improves work and makes the world better [1].

In reality, technology has played a very important role in how we live in the world today and how we communicate in the atmosphere with everything around us. So we are developing new innovations to live in a better life. As a result of technological advances, they are increasing and spreading across countries. The positive impact of technology on society has led to change and helped us to reach new heights that have never before been conceived of. We can see the uses and role of information technology in our society in many areas such as business, education, finance, healthcare, security, communication, employment and others.

Information technology (IT) involves the study and application of computers and any type of telecommunications that store, retrieve, study, transmit, manipulate data and send

information. Information technology involves a combination of hardware and software that is used to perform the essential tasks that people need and use on everyday basis.

Information technology needs computer program. A computer program is a collection of instructions that can be executed by a computer to perform a specific task. A collection of computer programs, libraries, and related data are referred to as software. Every software was once a project. A project life cycle is the sequence of phases that a project goes through from its initiation to its closure.

The five key process groups are initiating, planning, executing, monitoring and controlling, closing.

1. Initiating. Defining what needs to be done. Initiating is all about kicking off a project with your team and with the client, getting their commitment to start the project. You bring together all of the available information together in a systematic manner to define the project's scope, cost and resources. The goal of the initiation phase is to take a loose brief of a project and define it in terms of what it needs to do and achieve in order to be successful [2].

2. Planning. This is a crucial process in project management. The planning stage is where the project plans are documented, the project deliverables and requirements are defined, and the project schedule is created.

3. Executing. This process is also known as the implementation phase, in which the plan designed in the previous phase of the project activity cycle is put into action. The intent of the execution phase of the project activity cycle is to bring about the project's expected results [3].

4. Monitoring and control. That means monitoring the project life to ensure the project is going according to plan, and if it isn't, controlling it by working out solutions to get it back on track.

5. Closing. This is considered to be the last process of the project activity cycle. In this stage, the project is formally closed and then a report is produced to the project sponsor/client on the overall level of success of the completed project [3].

After the project charter is created by the sponsors, the project manager starts developing the team and hiring people, usually the business analyst is the first person to join the team after the project manager. Business Analysis is the set of tasks, knowledge, and techniques required to identify business needs and determine solutions to business problems. Solutions often include a systems development component, but may also consist of process improvement or organizational change.

Those performing business analysis are today known by a number of titles such as business analyst, business systems analyst, systems analyst and others. A business analyst works as a liaison among stakeholders in order to elicit, analyze, communicate and validate requirements for changes to business processes, policies and information systems. The business analyst understands business problems and opportunities in the context of the requirements and recommends solutions that enable the organization to achieve its goals.

There are different types of requirements:

1. *Business Requirements* describe such things as the reasons why a project is initiated, the things that the project will achieve, and the metrics which will be used to measure its success.

2. *User Requirements* describe the needs that a given stakeholder has and how that stakeholder will interact with a solution. User Requirements serve as a bridge between Business Requirements and various classes of solution requirements.

3. *Functional Requirements* describe the behavior and information that the solution will manage.

4. *Quality of Service Requirements* capture conditions that do not directly relate to the behavior or functionality of the solution, but rather describe environmental conditions under which the solution must remain effective or qualities that the systems must have. They are also known as non-functional or supplementary requirements.

5. *Assumptions and constraints* identify aspects of the problem domain that are not functional requirements of a solution, and will limit or impact the design of the solution.

6. *Implementation requirements* describe capabilities that the solution must have in order to facilitate transition from the current state of the enterprise to the desired future state, but that will not be needed once that transition is complete [4].

Requirements management is the process of eliciting requirements from the business then analyzing the requirements and presenting them in a way that clearly communicates to the stakeholders. Requirements management includes the following: elicit requirements from the business, by conducting requirements elicitation meetings, JAD sessions, interviewing, etc. Eliciting requirements is a key task in business analysis. Because the requirements serve as the foundation for the solution to the business needs it is essential that the requirements be complete, clear, correct, and consistent. Leveraging proven means to elicit requirements will help meet these quality goals [4]. 40-60% of all project defects are associated with this stage.

There are several techniques that you will be using to gather requirements from different subject matter experts. Some books define the requirements gathering tools and techniques as follows: Interviews, Focus groups, JAD Sessions, Questionnaires and surveys, Observation, Prototype.

In addition to the techniques for eliciting requirements, various techniques for modeling business processes are distinguished. Processes are modeled to visualize how the process works. There are a variety of models and graphical representations of business entities that may be used to create the Business Architecture:

1. *The Component Business Model* has evolved from traditional views of a business, such as business units, functions, locations or processes.

2. Business *Process Models* are often referred to as *Activity Models*. They describe the process associated with business activities and the information exchanged between activities.

3. A *Class Model* describes static information and relationships between information.

4. Business scenarios are a valuable technique that may be used as an input to the development of the Business Architecture to help identify and understand the workings of the business, and thereby to derive the business requirements and constraints that the architecture must address [4].

Information systems and technologies are present in every area of our life today. And we, as users, always want the applications to work correctly and facilitate some tasks. Various models, techniques, and graphical representations of the processes have been developed to facilitate the identification of requirements and the understanding of business processes.

Most defects in projects are associated with poor quality requirements elicitation. Therefore, it is so important that at the stage of collecting requirements and analyzing them, all the wishes of customers and stakeholders are collected.

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Antonchic A., Khomenko E.

Economic Security and the Globalization Process

Belarusian National Technical University
Minsk, Belarus

The problem of economic security and its provision is a phenomenon that has received recognition in both domestic and world literature. Currently, many studies are carried out on the economic security of the state, society and the individual. There is practically no aspect of state security that does not directly depend on ensuring its economic security. At the present stage of development of the Republic of Belarus, the issues of economic security of the real sector of the economy are of great importance. Stability and financial sustainability in terms of economic security are the foundation for successful development which helps to improve the well-being of society as a whole.

Economic security is a complex socio-economic category which is influenced by the continuously changing environment of material production, external and internal threats of the economy. Economic security is a basis of the national security of the state. The national security ensuring is a primary responsibility of the State, which is being implemented in close collaboration with the economic agents. The national security reflects the ability of relevant political, legal and economic institutions of the State to protect the interests of its key entities in national economic traditions and values. Therefore, its development must be seen in the overall context of the formation of the national security state.

The most summarized and logic characteristic of economic security must include three most important elements [1]:

– economic independence, which in current conditions means the ability of the state to exercise control over national resources, achievement of such level of production efficiency and quality of products that could ensure its competitiveness and enable equal participation in world trade;

– stability and sustainability of national economy, which involves protection of property in all its forms, establishment of reliable conditions and guarantees for business activity, prohibition of the factors that are capable to destabilize the situation (tough policies related to counteracting illegal takeovers, curtailment of corruption within the government, the judicial system and appropriate foreign economic policy);

– the economic progress, which provides for the establishment of a business-enabling environment for investments and innovations, continuous modernization of production, state support of strategic industries, search for new lines of activity that are necessary for national economy's sustainability and self-preservation.

Thus, in the scientist's opinion, the scope of *economic security* concept can be disclosed through the set of conditions and factors that ensure national economic independence, its stability and sustainability, and ability to steady progress [1]. At the same time, the economic literature highlights that the essence of economic security is disclosed within the system of criteria, indicators, and threshold values. However, it is noted that, first of all, it is necessary to classify the threats to economic security that refer to the factors that make it impossible or complicate substantially of the process of national interests implementation, representing the threat to livelihoods of the nation, its socioeconomic and political systems. Therefore, taking into account the economic

development peculiarities, identification of the current challenges and threats and their elimination must be the priority elements for the national economic policy.

World economy became more predisposed to economic crises, deep recessions which imply their sudden spread from a country or region of the world to others. Economic liberalization was accompanied by a growth of systemic shocks which triggered a systemic insecurity, hard to cover via standard insurance forms. Along with globalization, economic crises from a country or region have higher chances to influence other economies. *Contagion* became a fear for all world countries – for instance, further to the crisis of the August 1998 Russian debt, two of the most affected countries in the world were Brazil and Argentina, even if their economic relations with Russia were almost inexistent [2].

Globalization is one of the main trends in the accelerated development of society. It affects almost all aspects of the existence of the state, including financial security. The essence of the term *globalization* defines the process of strengthening integration ties between peoples and states, rallying their political, economic, social and other forms of relations to bring them to uniformity [3]. Like any process, globalization has both positive and negative sides.

The positive meaning is interpreted as another possible way to build competent and productive international relations, strengthen integration ties between states and improve import and export processes. The negative side of this process is that globalization can have a negative effect on the state of economic security in the state, since the country's economy is becoming more open and accessible for intervention by other states. The dependence of the national market on the markets of other powers appears. At the same time, difficulties in society and in the economy can aggravate, and the lack of raw materials can acquire a global character.

The key threats to the impact of globalization on economic security include [3]:

– difficulties in contouring a domestic manufacturer with foreign ones;

– loss of the sovereignty of the country's economy;

– uneven distribution of public goods between countries;

– decrease in economic security due to increased economic dependence (import dependence) and deterioration of the position of domestic producers.

According to domestic experts, it is import dependence that can lead to the filling of the national market with foreign food and consumer goods. The increase in foreign products in the domestic market prompts the country to make a reasonably necessary decision to increase the competitiveness of domestic producers. This can serve as an impetus for reducing the production cost, as a result of which prices fall, modernization and the introduction of new technologies. All these factors will affect the situation of stabilizing the economy in a better, more productive way.

Among other things, threats to domestic producers help to attract attention from the state for the application of various measures towards supporting protectionism, which will ensure the strengthening of Belarusian production in our country. But do not forget that the process of globalization is also positive, which gives a number of certain opportunities for the state and its people [3]:

– the emergence of the need for the development of the competitiveness of domestic producers, hence - improving the quality of goods;

– increase in labor productivity and rationalization of production;

– increase in investment opportunities;

– development of the economic potential of the state;

– development of new technologies.

According to some scientists, there are the most important tasks of the mechanism for ensuring the economic security of the Republic of Belarus in the context of the globalization of the world economy [3]:

– optimizing the state regulation system in order to eliminate threats to economic security:

– improving the quality and standard of living of the population;

– encouraging the growth of the country's scientific and technological potential;

– developing communication between the country and foreign manufacturers by improving the information and communication sector.

In our opinion, in order to increase the competitiveness of a national producer, it is necessary to improve methods of control over the quality of final products, as well as to gradually move away from the export of resources and raw materials towards the production of finished and processed products. It is thanks to equal and productive rivalry between countries that the Republic of Belarus can expand world economic ties. This will lead to potential development progress of economy and the reduction of threats to economic security.

In conclusion, I would like to say that the globalization of the world economy cannot be viewed as only a *good* or only a *bad* process. Globalization provides new opportunities for the development of the state; it can entail various threats to economic security. But with the correct approach of one or another state to the possibilities of globalization, a constant striving for world cooperation, for minimizing threats to economic security will serve to increase the general welfare and successful existence of all states on the world stage.

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Miatselski A., Khomenko E.

Application of BAT in the Dairy Industry of the Republic of Belarus

Belarusian National Technical University
Minsk, Belarus

The dairy industry is one of the priority sectors for the development of the economy of the Republic of Belarus. It is planned to reach the production of 9.2 million tons of milk per year by 2021, which means that productivity will increase almost 1.3 times without expanding the dairy population.

The dairy industry of Belarus is dominant in the processing industry, as it produces the most important food products for the country's population. The largest enterprises in the industry are: Savushkin Product, Babushkina Krynka, Bellakt, Berezovsky Cheese-Making Plant, Slutsk Cheese-Making Plant, Glubokoye MKK, etc. Figure 1 shows the production volumes [1].

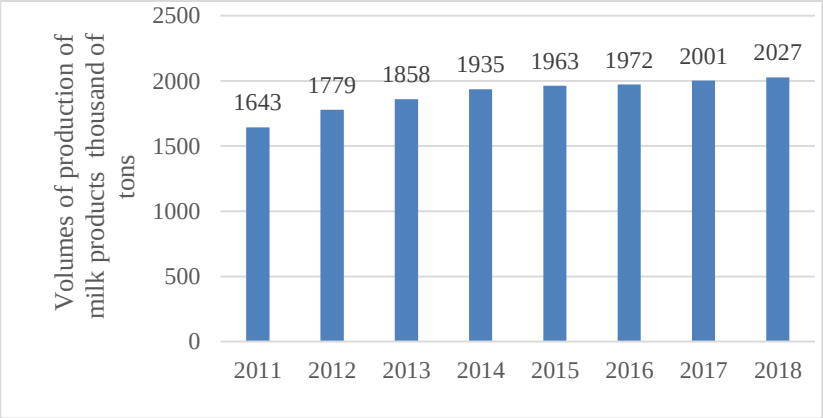

Figure 1. Volumes of production of milk products (in terms of milk) in the Republic of Belarus

The production activity of dairy enterprises is a source of impact on the atmospheric air in the form of emissions of pollutants, the formation and pollution of waste water, as well as the generation of waste. Wastewater from factories is relatively polluted, especially with organic compounds. The concentration of organic compounds in wastewater is mainly due to the loss of raw materials and dairy products during production (milk, curd mass, whey, etc.). After cleaning equipment and premises wastewater contains a significant amount of organic pollutants and is classified as industrial wastewater. It must be treated. When 1 m^3 of untreated waste water is discharged, 40-60 m3 of natural water is contaminated [2].

The main sources of air pollution in the main production are the following equipment and workshops:

1) production of whole milk powder and skimmed milk,
2) cheese making shop,
3) steam power equipment, etc.

In addition to the impacts resulting from water consumption and emissions into the atmosphere, production wastes are generated directly at the dairy industry. The main ones are packaging of polyethylene, polystyrene, polypropylene, worn tires, waste technical oils, waste of ferrous and non-ferrous metals, etc.

The formation of solid organic waste at milk processing enterprises is mainly related to the nature of technological processes. In addition, waste is generated as a result of product packaging, storage and sale. The main waste of the dairy industry is sour whey, which is obtained as a result of the processing of whole and skim milk into cheese, cottage cheese and technical casein

The main reasons for the incomplete use of whey are a sharp seasonality in its production, rapid spoilage and insufficient stability of the products produced from it, the remoteness of raw materials from the points of sale of these products, the relatively high cost of a feed unit of whey and difficulties associated with its transportation [3].

In the context of integration into the world economic community, the task of increasing the competitiveness of various spheres and types of activity is especially urgent, which is due to the presence of negative consequences of the instability of the external environment, which significantly weaken their positions in the domestic and foreign markets.

Green economy is a new direction for Belarus, associated with sustainable use of natural resources and social approval of newly created projects [4]. The implementation of the principles of *green economy* is aimed at increasing the potential of the Belarusian economy, regional development, and improving the quality of environmental components. One of the tools for realizing *green economy* can be the introduction of the best available technical methods.

The BAT (Best available techniques) concept is widely used in Europe and the Russian Federation. BAT in the context of European Union regulations is a tool for monitoring and preventing negative impact on the environment, taking into account the specifics of a particular industry. The experience of the European Union in identifying, implementing, evaluating the effectiveness of BAT in various industries for all aspects of production is summarized in the relevant BAT reference manuals.

Based on the definition of BAT, the following areas can be distinguished: optimization of energy consumption; use of resource-saving methods in production; reduction of waste generation and their use as secondary raw materials.

It is assumed that the use of BAT makes it possible to ensure: use of cleaner production methods to prevent and minimize, where possible, emissions discharges to air, water and soil, including the generation of hazardous and solid waste; reduction of discharges emissions based on the use of the most appropriate equipment for the treatment of waste streams in all components of the environment; use of the most appropriate methods for the disposal of solid and hazardous waste after analyzing the possibility of recycling waste; unconditional consideration of the economic efficiency of the considered means, bearing in mind that the method should not cause excessive costs for the enterprise.

Examples of BAT are well-planned production schedules and identification of prevention and mitigation options. Well-planned production schedules minimize the number of switchings from one product to another and reduce waste generation, water consumption and wastewater generation.

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Skachinskaya O., Khomenko E.

Innovative Activity of Small and Medium-sized Enterprises of the Republic of Belarus in the Context of International Comparisons

Belarusian National Technical University
Minsk, Belarus

The scientific and technological revolution, which was a qualitative leap in the development of the productive forces, made the economy substantially dependent on the achievements of science and technology. At the same time, the process of introducing new ideas, solutions, technologies into production is interpreted in economic science as the transformation of potential innovations into real products and technologies and is mediated by the concept of *innovative activity*. This concept is based on the term *innovation*, first introduced into scientific use by the famous Austrian economist Josef Schumpeter, who not only laid the systemic theoretical foundations for innovation, but also showed the role of innovation in the processes of changing technology and management. He viewed innovation as a mediator between invention and its implementation in the economy. Today there are many interpretations of this concept.

According to the Interstate Standard 31279-2004 «Innovation Activity Terms and Definitions» innovations are new or improved technologies, types of products or services, organizational and technical solutions of a production, administrative, commercial or other nature, contributing to the promotion of technologies, commodity products and services to the market. And innovative activity is the process of creating innovations, which includes applied research, preparation and

start-up of production, and activities that ensure the creation of innovations – scientific and technical services, marketing research, training and retraining of personnel, organizational and financial activities.

The motives of innovative activity can be:

- *strategic advantages*:

a) creating a favorable business reputation in the eyes of consumers, potential partners, investors;

b) increasing production efficiency due to the modernization and renewal of production facilities;

c) ensuring the development of an enterprise through the expansion of sales markets and diversification of activities.

- *increase in the profitability of an enterprise due to*:

a) temporary monopolization of the market and the possibility of obtaining super-profits from the implementation of radical new products;

b) improvement of the quality and competitiveness of products;

c) increase of the share of the product on the market.

- *reducing the costs of economic activities due to*:

a) restructuring activities;

b) reducing unproductive costs;

c) saving energy and raw materials through the introduction of saving technologies;

d) cost savings as a result of the use of secondary raw materials;

e) minimizing rejects.

- *special benefits*:

a) information and legal support from the state and private structures;

b) preferential taxation;

c) concessional lending.

Analysis of innovative activity of SMEs in Belarus and other countries

Any innovative activity begins within an enterprise. The experience of most developed countries shows that small and medium-sized enterprises are a fairly effective and most dynamically developing sector. The advantages of small enterprises in the innovation sphere are manifested in the following:

- flexibility and initiative in making management decisions;
- increased creative initiative;
- active adaptation to constantly changing technological and market conditions;
- prompt response to changes in market conditions;
- increased susceptibility to new, original innovations and technologies;
- lack of bureaucracy and formalism in the activities of an enterprise;
- high ability to diversify products in accordance with the dynamics of demand;
- relatively low capital intensity;
- fast return on investment.

But despite the advantages mentioned above, SMEs in Belarus are rather passive in terms of introducing innovations. This can be seen by analyzing individual indicators of science and innovation development. Indicators – orienting economic indicators, measuring instruments that allow to foresee, to a certain extent, in which direction the development of economic processes should be expected.

The European Innovation Scoreboard (EIS) is a multi-indicator review of the results of the European states' innovative development within the European Union Initiative. The system of indicators of the European Innovation Scoreboard characterizes scientific and innovative activities in

different aspects and allows comparing countries in terms of their level of innovation. The structure of European Innovation Scoreboard allows to consider in a logical sequence along the chain *support - activity - results* the following:

- the ability of human resources to perceive innovations,
- the level of education of personnel,
- the level of financing innovative projects,
- the degree of state support for research and innovation,
- costs of research, development and innovation,
- efforts of firms in the field of innovation cooperation,
- innovative activity of organizations and economic effects from innovative activity.

According to the EIS-2019, the share of organizations engaged in innovative activities in the country is extremely small. But, in general, there is a positive trend in the indicators of innovative development (Figure 1.)

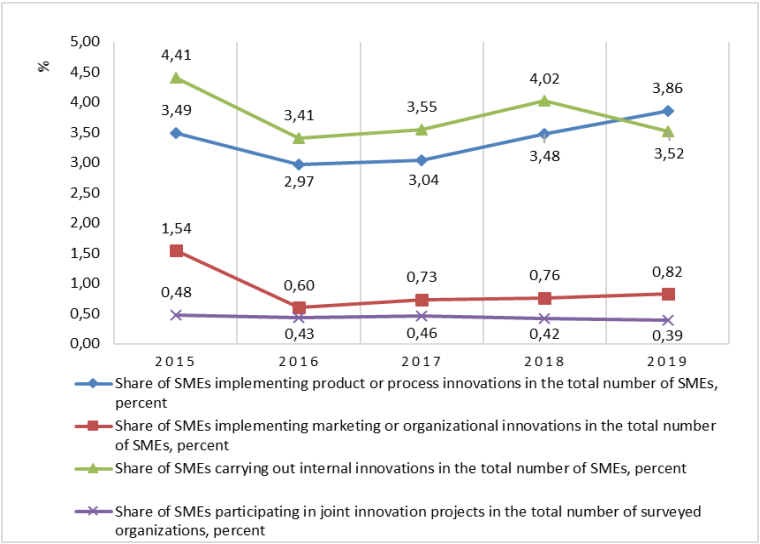

Figure 1. Dynamics of SME's innovative activity indicators in the Republic of Belarus

To confirm what has been said, let's consider the table with similar indicators of the countries – leaders of the European Innovation Scoreboard (Table 1). Comparing the innovation activity of SMEs in the Republic of Belarus with innovation leaders, it can be noted that some values of the indicators presented in the table are more than 10 times higher than those in Belarus.

Table 1. Indicators of the leading countries' innovation activity according to the European Innovation Scoreboard (EIS-2019)

The country	Share of SMEs implementing product or process innovations in the total number of SMEs, percent	Share of SMEs implementing marketing or organizational innovations in the total number of SMEs, percent	Share of SMEs carrying out internal innovations in the total number of SMEs, percent
Belarus	3,86	0,82	3,52
Switzerland	44,8	58,4	36,9
Sweden	38,3	36,3	33,5
Finland	54,2	44,80	48,50
Denmark	33,3	39,20	23,60
Netherlands	48,5	31,6	35,0
Luxembourg	40,4	52	35,1

It should be noted that the development and implementation of innovations as a form of activity aimed at creating new or improved products, services and technologies is considered in European countries as the main issue of increasing the competitiveness of companies and the growth of

the economy as a whole. Small and medium-sized enterprises (SMEs) form the backbone of the European economy. They represent 99% of all businesses in the EU.

The Swedish experience shows that the main thing is not to achieve the status of a developed leading country, but to keep it. And this is done in conditions of the strongest competition. Thanks to the development of the Swedish national innovation system, Sweden is ranked second among the countries investing in the development of high-tech and knowledge-intensive products.

Technology development in Sweden is carried out in three main areas: medicine, biology and biotechnology; information and telecommunications; ecology and climate control.

Due to these technologies, the country takes one of the leading places in the international market and attracts many scientists from other countries.

The results of the research showed that there are problems in the development of innovative activity of small and medium-sized enterprises of the Republic of Belarus. There are several recommendations on which ways it can be activated: subsidies for the development and promotion of new technologies, goods and services; full or partial compensation of bank interest from special funds or the state budget; investment tax credits; introduction of tax breaks and vacations; use of innovation vouchers; use of preferential depreciation regimes for high-tech equipment; expanding the possibilities of leasing financing for the modernization of production; assistance with patenting; development of venture financing; systematization of objects of innovation infrastructure.The implementation of the proposed measures can contribute to strengthening the role of small and medium-sized innovative enterprises in the economic development of the Republic of Belarus.

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Bykov G., Bankovskaya I.

Sports Engineering

Belarusian National Technical University
Minsk, Belarus

Sports engineering is a branch of science and technology concerned with the purposeful creation and use of objects of industrial property in the field of physical education to improve the effectiveness of training and competition processes.

Sports engineering is still a very young branch of science. Engineering and engineering methods here refer to the whole range of methods for studying the movement of various sports apparatuses and the dynamics of many sports. These methods include both purely theoretical methods (mathematical and computer methods of motion analysis) and methods based on direct measurements of certain characteristics of an athlete or group of athletes. Sports equipment is all kinds of special equipment and implements that are necessary for a good sporting experience. Each sport requires its own set of sports equipment [2]. It is a term that summarises the use of various sports equipment, apparatus, devices, mechanical and electronic devices, the use of which is stipulated by the competition rules for particular sports. Most modern sports involve the use of sports equipment (ball, barbell, discus, javelin, kettlebell, mace, ribbon, uneven bars, beam, etc.) and/or special devices (skis, skates, helmet, stick, glasses, bicycle, parachute, ice axe, etc.) which are integral to the sport, contribute to achieving the highest achievements in a particular sport and/or ensure safety. There are several main groups of such items: - projectiles and equipment (apparatus); - sports uniforms (clothing and footwear); - competition equipment; -

equipment for the maintenance of sports facilities. At the same time, the structure in each group is even more diverse. For example, the equipment group includes both, basic sports equipment (clubs, rackets, balls, etc.) and training aids, training devices, etc. It is the quality of the equipment that determines how comfortable and safe your sporting activities will be. The quality of equipment also has a huge impact on an athlete's performance level. Sports industry in the production of sports equipment widely uses the latest scientific and technological advances. Thanks to scientific and technological progress and its implementation in sports, it is possible that an athlete wins not because of his physical and intellectual abilities or capabilities, but because he has an equipment that his rivals do not have. Sports equipment is classified according to the sport for which it is used. But besides direct use in those or other sports, sports equipment may be used to equip sports halls, both general purpose and specialized (such as boxing rings, tennis courts, and others). Special sports equipment may also be designed for outdoor sports grounds or for swimming pools. This may be a variety of products as used for flooring, grounds, and can be all kinds of simulators and shells. Sports equipment may belong to different groups: for example, electric, power, magnetic and other kinds. What all these products have in common, however, is that they must be safe to use: they must not be toxic, many must be durable and not break or bend, i.e. they must be able to withstand considerable strain. Today, sport is at the edge of human capabilities [1]. Increasingly, progress depends on high-tech tools to train and diagnose athletes. In swimming, for example, we are talking about thousandths of a second, and experts are puzzling over how to make the start or turning technique as rational and efficient as possible. In javelin and hammer throwing it is important to understand clearly how the neuromuscular apparatus of the athlete and how intermuscular coordination is distributed. 30

years ago it took the coach hours to calculate each movement on a piece of paper, but now with video capture systems we have a 3D view of the athlete's movements online. Now we can easily evaluate by technical means not only the general physical preparedness, but also the physical, technical, tactical, technical-tactical and even moral-willful preparedness. Everything can be measured in numbers.

To improve the efficiency of technical training of athletes at the present stage of sports development, it is necessary to solve at least three problems. The first one is that there is no consensus among specialists on the meaning of some terms from the arsenal of concepts in the theory of physical education and sport, which, unfortunately, introduces serious and sometimes irreparable errors in the strategy of sports training in general. The second problem is that the theory and practice have not sufficiently investigated the most significant aspects of the development of rational samples of sports technique in various sports. The third problem is that the methodological support of the training process of highly skilled athletes in most sports focuses, as a rule, on increasing their functional capabilities. At the same time, there is a tangible lack of special scientific developments on the improvement of competitive technique and the process of technical training itself.

The scope of the specialist's professional activity:

- Organise and carry out the operation, repair and maintenance of the engineering and information systems of the sports facilities;
- Organisation and management of the activities of sports facilities;
- Manufacturing (design, construction, assembly, adjustment and testing of sports equipment);
- Sports (assembly and maintenance of sports equipment);

- Education (auxiliary support of the educational process in the laboratories of the departments of technical and physical education universities on special disciplines related to the technical support of sports; assisting in the training sessions);
- Science (study of operating processes and determination of characteristics of devices related to sports equipment, their units and mechanisms;
- Development of innovative technologies for training athletes with the use of new technical means, contributing to the achievement of high sports results).

In conclusion, we would like to note that until recently Belarus could not boast of such technical provision of facilities with technical means. The development of the material and technical basis of the physical culture and sports industry in recent years has required the involvement of qualified engineering staff, proficient in the design, creation and operation of technical facilities used in modern sports. The globalisation of the world economy enables us to use advanced foreign technological components to develop and produce our own innovative sports equipment and implements using our main reserve - our scientific potential. Thus, the development of innovative engineering technologies will be accompanied and increasingly influenced by sports. There is an urgent need to address the use of "technological doping" in sport and to exploit the new possibilities of sports engineering for the development of sport.

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Navoyeva A., Bankovskaya I.

Modern Engineering and IT Methods in Agriculture

Belarusian National Technical University
Minsk, Belarus

The agro-industrial complex takes an important place in the economy of each country. It is a socially significant sector, which accounts for almost a fifth of the country's GDP, about 20% of fixed assets, almost 30% of all employees of the national economy.

It plays the leading role in supplying the population with food and in the production of raw materials for the food and partly light industry. Approximately 2/3 of the retail trade turnover in the Republic of Belarus is made of agricultural products and goods made from agricultural materials. Agriculture is designed to fulfill three major tasks: first, to provide the country's population with high-quality food; secondly, to supply the food and light industry in sufficient quantities with the necessary raw materials; third, to preserve attractive landscapes as a living space, a territory for resettlement of people, the creation of recreation areas, zones for the development of agritourism.

Analysis of the most important indicators of the development in modern agriculture indicates positive trends in the agro-industrial complex. Belarus has become not only self-sufficient in the food supply but also an export-oriented country. The amount of agricultural products in total exports increased from 13.4% in 2010 to 16.7% in 2015. Agriculture has become a high-tech area. Traditional peasant labour in countries with advanced agriculture is being replaced by the latest information technology and biotechnology. Automation

of the main technological processes of agricultural production in Belarus made it possible to increase labour productivity in agriculture by 1.4 times over the five years; 1,184 dairy complexes were commissioned and technically re-equipped. A large-scale modernization of industry and agriculture has been carried out. For these purposes for 2011–2015 more than $ 40 billion were invested. The modernization of production has made it possible to significantly reduce the costs of agricultural production. Also, new technologies will help increase yields and, as a result, increase revenue. Phenotyping methods can become one of the solutions in modern agriculture. Phenotyping or high- phenotyping (high-throughput phenotyping), shows significant progress and has great potential in recent years for all areas of fundamental and applied plant biology. Its development led to the formation of " plant phenomics " - a fundamental section of plant physiology, which concentrates on identifying the patterns of formation, organization and change of plant phenotypes (a set of phenotypes) in relation to the influence of external factors, characteristics of the genotype, patterns of gene expression and the functional manifestation of proteins [2].

The emergence and formation of plant phenomics are directly related to the progress in the registration of digital images and the development of computer and systems biology. Therefore, much attention of physiological researchers is directed to the improvement and further development of phenomic platforms, sensors, robotics, as well as software at all stages of phenotyping. The availability of obtaining, analyzing, storing and processing digital RGB images formed the basis for the creation of the first phenomic platforms – software and hardware systems adapted for specific experimental needs. Coming out of the RGB range, i.e. visible part of the spectrum of electromagnetic radiation, in recent years has further expanded the possibilities of phenotyping.

The most popular phenomic platforms are LemnaTec (Germany), The Photon Systems' Instruments' (Czech Republic), Qubit Phenomics (Canada), Phenomix (France), Phenospex (Australia), of Delta - T Devices' Ltd . (The United Kingdom), WPS (Netherlands), WIWAM (Belgium), and VBCF (Austria). They account for almost 100% of the phenomenal equipment. Phenotyping software is very diverse and constantly adapts to new tasks. An overview of software products and solutions for phenomics is provided by the Plant Image Analysis portal [1]. At the beginning of 2020 this Internet resource presents more than 200 computer programs and 30 databases for conducting phenomic research. Corporate systems of large manufacturers have their own closed-source software products. Currently there is an active development of machine learning systems (artificial neural networks) for applications in the field of plant phenomics, which, according to some estimates, in the near future will transform the market for phenomic software and determine the way for further developments in this direction. It is predicted that programs based on artificial neural network technologies will eventually replace classical image analysis systems. Nevertheless, there are no ready-made commercial products based on machine learning systems on the market so far. So at the moment we still need specialists to interpretate the data with “old style” software and make decisions about plant status.

At the moment this equipment is available, and the competitive market makes it possible to receive good offers for its purchase. Current market for basic phenomics hardware, a variety of phenotyping sensors and software is estimated at $ 318 million per year, with a projected increase to $ 2 billion by 2025. Currently the price of a high-performance conveyor-type platform is between $ 5 million and $ 50 million depending on installed sensors and throughput. Fixed platform prices start at $ 0.5 million. These figures are approximate. The real cost of

the complexes will depend on the specific tasks, the degree of automation of the enterprise and the volume of production [2].

As we can see, phenomic platforms are quite promising in terms of increasing farm productivity and cost savings in the long term. The experience of foreign enterprises and research groups can be applied in Belarus. Based on the foregoing, the application of modern technologies can bring to the Belarusian agriculture bigger volumes of production and higher quality products at lower fertilizer amount and personnel costs.

The degree of development of industrialization and the widespread introduction of new technologies unquestioningly lead to the transition of the world to a new digital era. This period is characterized by the rapid development of high technologies penetrating all spheres of our life. If at the turn of the century no farming enterprise around the world used sensor technologies, then by 2025 their use is expected to increase to more than 500 million sensors, and by 2050 – more than 2 billion smart agricultural sensors.

Considering the modern economy of the country and the development of the agricultural sector, the introduction of the technologies described above may be the right step for Belarus. In addition, it is possible to create your own phenomic systems and methods for data processing, which will open up markets for Belarus and make it even more accessible to local consumers.

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Vinnik K., Zagrebaylov V., Bankovskaya I.

Can We Go Back to the Future?

Belarusian National Technical University
Minsk, Belarus

How has the last month been for you? When I wrote my welcome for April's issue of TVBEurope I never dreamt we'd still be in lockdown when I came to write this one. Possible naivety on my part, I'll admit, but by the time you read this, the UK will be in its sixth week of lockdown and a new normal has been adopted by millions of people. Of course the one thing that hasn't changed is our voracious appetite for content, be that news and information or something that will take our minds off the current situation. Over the past four weeks we've seen audiences soar for both traditional TV and streaming. It seems the big winners of the current situation (if I can call them that) are the streaming services which have not only seen their audiences rise but also their valuations on the stock market. At one point in April, Netflix was worth more than Disney. Who would have predicted that six months ago?

Of course it remains to be seen whether audiences will stick with streaming and pay-TV services once lockdown eventually ends [2]. Pay-TV should see viewers stick around for longer as contracts usually run for 12 to 24 months, but the streaming services could see a major churn in subscriber numbers once everything calms down. We'll definitely be keeping a close eye on that in our Daily newsletter. Once lockdown measures do begin to ease there's going to be a whole host of live content that viewers are going to be eager to watch, particularly sport. While there's still a lot of discussion around how sports events will be staged, we know that viewers

will want to watch, however that staging happens. The question then arises, can the infrastructure cope? So far, the internet has managed to up pretty well as everyone works from home and steams content. But when millions want to watch live sport via OTT services, will those same protocols hold? It might not be the case of one football match available via OTT, but instead there could be multiple games at the same time. While Amazon's first foray into streaming the Premier League last December was well received by football fans, the maximum number of live games streamed at any one time was just five. As the Premier League, and the lower divisions, try to complete the 2019/20 season as soon as possible, are we likely to see an increase in matches played at the same time and streamed to viewers? Can domestic internet cope with the strain on bandwidth? And, that's just for one sport. Finally, I've been thinking about what the future holds for trade shows.

What does the postponement of the olympics mean for 8K? The sporting world entered 2020 with the firm expectation that 8K Ultra High Definition (UHD) technology [1] would come into focus I for the first time. For almost a decade, major broadcasters have been ramping up their efforts with the end goal of delivering the 2020 Olympic Summer Games in Tokyo in 8K UHD. Since then, the COVID-19 virus has irrevocably changed every aspect of global society. With the sporting landscape now firmly on hiatus, broadcasters and content owners are looking towards 2021, with some sections of our industry now asking what implications this could have on potential 8K rollouts. To understand what the future might hold for 8K, it's important to note the progress made so far. There are obvious associations between major sporting events, the adoption of TV technology and the replacement cycles of legacy TV electronics. Yet, what is often forgotten is the best viewing experiences are often already achievable through far simpler implementations. Until we see the widespread

availability of 5G and the development of next-generation video compression technology, such as Versatile Video Coding (VVC), it will be some time before major progress is made in reducing the bitrate required for 8K UHD streaming. Any future shift to 8K involves a huge ecosystem change, and despite the best efforts of many leading TV manufacturers and some broadcasters, consumer eyeballs and wallets aren't clamouring for 8K capable TVs just yet. While there are many 8K-capable TV sets on sale today, the equipment needed to produce and distribute the content is not fielded widely, due to both technology maturity and the economics involved.

Ultra HD forum updates the industry by Ben Schwarz. The Ultra HD Forum was excited about the prospects for UHD in 2020. Then COVID-19 happened. As we put this article together I from home, people throughout the world are in various situations of lockdown [2]. Restrictions in movement make electronic media the most convenient window to the outside world. Video consumption and teleconferencing have exploded in usage. Tech-resistant people have embraced this trend, and geeks have been digging even deeper into newer, often disruptive services. Embracing new video services has become a mass audience phenomenon. Concurrently, there's consensus that we're heading for a recession. But there will be a rebound predicted for the second-half of 2020 or the first half of 2021. Combining rapid economic growth, pent-up demand and renewed consumer enthusiasm with Japan's long-term commitment to HDR and higher resolutions, promises to turn the games into a significant growth opportunity for UHD.

COVID-19 has also brought challenges to internet traffic management. Daytime streaming has seen a 40 per cent increase in some markets, while analysts talk of an overall 20 per cent increase in traffic. Major OTT UHD services have reduced per-stream bandwidth, leading to a decrease in perceived quality. The Ultra HD Forum supports a multitude of

proven technologies. One that is particularly relevant here is Content-Aware Encoding. Using the latest AI and ML techniques, this approach to encoding brings bandwidth saving of up to 50 per cent without any significant loss of perceived quality. Since its inception, the Ultra HD Forum has published Guidelines for the UHD community, available freely. This new release, version 2.3, offers a holistic view of all existing UHD technologies. The Guidelines use the concept of a "foundation layer", consisting of readily available mature technologies, and an "enhancement layer" including newer, more leading-edge technologies. Throughout the Guidelines development, more than 35 other member companies have contributed to the effort.

So many of the processes we are used to in modern shooting – low pass filters, debayering and more - reduce resolution, so starting with as high a pixel count as possible is always going to be an advantage further in the production process. No one is really saying that every 8K shoot now is likely to be watched in 8K anytime soon though that future proofing argument is always there in the background and should not be discounted – but you will get a much better deliverable at any format as a result. And for anyone shooting for VFX work, that extra detail is going to lead to much cleaner composites, even if the VFX work itself is being done at lower resolutions. Beyond the technical, there are plenty of creative reasons for shooting at 8K as well. Reframing is one of them.

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Bartashevich Y., Oleynik O., Beznis Y.

Viral Marketing as an Alternative Advertising Method

Belarusian National Technical University
Minsk, Belarus

In modern realities there is a huge selection of goods and services, each of which needs non-standard and effective methods of attracting consumers. The greater the number of such products and services is, the more creative the marketing activity should be. In this regard, companies are beginning to resort to methods of promotion that are alternative to direct advertising, viral marketing being one of them. Viral marketing is a marketing activity in which information about a product spreads between people, especially on the Internet [1]. This term was first mentioned in the article «The Virus of Marketing» in 1996. In this article Jeffrey Rayport drew an analogy between the proliferation of biological viruses and marketing messages [2]. The main difference between this very method and other conventional methods is that the main force for spreading information about a product or service is people. The company creates an advertising product, which is a video, photo, article, official product with the symbolism of the advertised object or other types of consumer attraction. In case this product involves users' attention then automatic distribution begins, and it becomes viral. Thus, without needing much money for promotion, the content covers a large number of potential consumers. The advantages of viral marketing include the following characteristics:

• costs only for creating an advertised product;

• non-intrusiveness since the consumer is not forced to watch the content;

• the advertised product is well remembered due to its simple and clear content;

• it keeps the consumer's attention longer, because companies often involve the person in brand-associated activities.

• inspire more confidence, since the distributors are familiar people, etc.

But this method also has a few disadvantages:

• unpredictability, since viral advertising may not interest the consumer, thus the invested funds may not pay off;

• there is no way to manage the distribution process;

• advertising can be so implicit that people may not notice a reference to the brand in it;

• the idea must be original.

To reduce the risks while creating viral advertising, you must stick to a number of rules. At first, the idea must be clear to the popular culture. So, any popular science article is distributed at a much lower rate than advertising involving cats. Secondly, advertising should be relevant and cause an emotional response from consumers, for example, you can touch on issues of concern to society at the moment. Third, an important aspect is to determine the target audience, its demands and the choice of how to provide information to this audience. Also viral advertising, like any other type of marketing activity, needs to evaluate the results. However, the implementation of these rules doesn't guarantee the success of an advertising campaign, as there are a huge number of external factors, including high competition in the field of advertising. Consider the application of this type of advertising on the territory of the Republic of Belarus. Now Belarusian Digital agencies are just beginning to implement viral marketing in the list of their services. Among those who provide this service in the Republic of Belarus, the following agencies can be distinguished: *VIDEOLAB.by, Create.by,*

Academia.by. The price of this service ranges from 2000 BYN to 9000 BYN. The final cost may increase depending on the complexity of the implementation of the advertising project [3]. One of the most outstanding examples of such advertising in Belarus is the advertising of an Internet portal for buying apartments *Domovita.by*. To do this, they created 4 videos with a talking cat to attract attention, which were distributed through Youtube, Instagram, Facebook, Yandex.Video. In total, these videos have gained 677 thousand views on the Youtube platform. According to the director and screenwriter of the video Pavel Stankus, the cat was chosen as the main character, because for many people cats are a symbol of comfort and moving to a new home [4]. Nevertheless, don't forget that there are no universal methods of promoting goods and services. No approach, including viral marketing, can guarantee the desired result. To get the maximum benefit from advertising activities, it is necessary to integrate viral marketing into traditional marketing.

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Bobryk D, Beznis Y.

Brain-computer Interface

Belarusian National Technical University
Minsk, Belarus

What is BCI? In 1960 DARPA (Defense Advanced Research Projects Agency) suggested the creation of an interface based on interaction with the brain. These interfaces work by scanning brain activity and translating it into commands. Due to the fact that the brain transmits information through neurons by electronic impulses, integration with electronics is much easier to implement. The brain-computer interface (BCI) is a system of information exchange between the human brain and an electronic device [1].

BCI, being an interdisciplinary field, combines a number of scientific fields such as neuroscience, physiology, engineering, information technologies, psychology and etc. The main goal of the BCI design is to develop ways for interpreting the information encoded in the electrical activity of neural groups using a computer system. These signals should be analyzed in real time and converted into control commands for the artificial device.

The first person to talk about BCI was Jacques Vidal, in his article "Towards Direct Brain-Computer Communication" in 1973 [1]. The basis for such technologies was founded by the fundamental work on the study of the cerebral cortex of I.P. Pavlov in the field of regulation and functioning of the cerebral cortex, which was later continued by the Soviet physiologist P. K. Anokhin, and N. P. Berekhteva in deciphering mental codes. The BCI technology has been developing rapidly since the mid-1990s. Several groups of researchers were able to capture

complex signals from the motor cortex by recording them from so-called neural ensembles (groups of neurons) and using them to control external devices. But the idea of BCI has received the most development during the last decade. The strategic goal of the past and current decades in this field is to fully recognize and create a model of the brain's electronic impulse pathways. The central nervous system is a complex communication network. There are 80 billion neurons in the brain alone, with trillions of connections between them. At any moment, the distribution of electrons changes in each neuron causing the reaction. Depending on the type of neurotransmitter, the nature of the transmission changes, and the reaction also depends on the nature and rhythm of the impulses, and most importantly on the system. So the nervous system is not just a collection of wires, but is a much more complex system [2].

The BCI functionality includes three stages. Firstly, the BCI reads commands based on the recording of electrical activity in the brain. The main task of this stage is to decipher the electrical signal. The program has a set of "patterns", or "events", consisting of various signal characteristics: oscillation frequencies, activity peaks, cortical locations, and other data. These signals can be read in an invasive or non-invasive way. In the first case, the scanning electrodes are implanted under the cortex or on its surface, and in the second, they are attached to the surface of the head, which is also known as electroencephalography (EEG) which then captures the field status at a particular moment due to the potential change during transmission

Next, you need to define the signal to determine the intentions behind it. At the second stage, the received signal is processed, its shape is refined, and interference with clear transmission is eliminated. There are two possible ways to decipher the data: the first algorithm, which is not limited by search parameters, classifies the "crude" signal itself and finds

elements, predicting intentions with the highest probability; the second decoding algorithm searches for the particular signal and codes itself through the execution.

The resulting cleared signal is already interpreted into binary code. After that, the signals are classified and sent to the control parts. Then the digitized signal is sent to the machine that executes the command.

In the development of BCI today, there are 4 main directions to be distinguished: brain-computer-brain feedback systems, high-precision processing of brain activity, technical improvement and miniaturization and neural conductors [3].

Obviously, the BCI has been widely publicized today. The technology has moved out of the sphere of pure theory and is now in the stage of active study and implementation. Since the end of the last decade, small and large businesses have been interested in developing BCI, and governments and private organizations have been creating laboratories to study the brain and integrate it with technology. Despite the fact that the main achievements in this field are connected with the help of people with disabilities, today many new ways of using BCI are being implemented in virtual reality games to autonomous vehicles.

The areas of the BCI application include: prosthetics, interactive interfaces, rehabilitation systems, virtual reality, stimulation systems.

Examples of the BCI implementation:

Exoskeleton - The Walk Again project, which is led by the IINN-ELS partner group of institutes led by Miguel Nicolelis. The developed exoskeleton allows a person to freely control their limbs and speed of movement.

Virtual Reality - The most well-known application of BCI, in such systems it is used for the most basic control, but according to assurances, this is the first stage and soon we will be able to get a full immersion technology similar to “The Matrix”.

Neurochat – An innovative project of the Russian group for neurocommunication and neurotraining, which allows you to type text arrays with the power of thought, train a person's cognitive abilities.

Exocortes – one of the important and promising developments is an external system to complement brain capabilities. The exocortex should be understood as an external computing machine connected to our brain and designed to increase its abilities.

Brain computer interface is the most perspective view on the human machine interaction. It provides enormous possibilities for enhancement of human mind and body, upgrading the quality of digital interfaces. Scientists have already implemented the results in the areas of medicine and e-entertainment. For sure, it will have much impact on the design of devices in the future.

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Kipenko Y., Beznis Y.

Prostheses and Augmentations in the Human Being

Belarusian National Technical University
Minsk, Belarus

Strangely, but prostheses are connected with humanity through thousands of years. If you ask why, there will be one answer. In each period of humanity people lost their parts and no matter what it was: teeth, fingers, or even arms and legs. No one wants to live with limitations so artisans, scientists and others have tried to create some substitutes. Some of them were primitive like a stick with a rope, or even a cane. In some way, a cane is a prosthesis which is not connected to the body by special means like a rope or belt and you can even say that a sword can be named like an implant too. No, it can't. First of all, implants, prostheses and augmentations are made to replace the less of human organism but implants are only replacement of lost body parts. Cane offsets the poor mobility that can be caused by illness, injury or senility while sword is just a tool of injuries. Also our history is full of examples of implants. Hook arms and wooden legs are the simplest and the most available for almost every human in every period of history [1]. Of course there were more scientific, complicated and expensive prostheses like golden teeth, steel limbs and etc. Let’s briefly run through some types of prostheses.

Anatomic prosthesis. This most widely-used type has a lot of subtypes but they are common. You can substitute your arm, leg, nose, tooth, even mammary gland. Arms and legs are replaced with an imitation or with a real-working implant. The illusive version is needed when patient is scared of his less and modern science doesn't know how to fix or replace his injury

by medicine or augmentations. Also when real-working implant is too expensive for the victim. But imitation and working model are like *exoimplants*. They are worn on the body part. Artificial fingers, ears, feet and brushes are placed on the skin without integrating into the body. Nowadays it is more safe and cheap and the biointegration of such massive implants has just started to develop.

The other type of augmentations are *endoimplants* that are embedded into the human body. The list of examples is very huge and some of them are tooth and mammary gland implantations and of course the plastic surgery. Teeth are implanted by integrating special foundation in the gum. And after that the prosthesis of the tooth is "worn" on this foundation. But there are four types of tooth implants that are different and similar at the same time. The first type is integrated into the bone, the second one is integrated in the bone too but it is used when the quantity of bone is less than needed. The bone is increased by some surgery and only then the implant is integrated. The third type is embedded in the piece of tooth when it exists. And the last type doesn't need the integration to the jaw bones. It builds into the mucous membrane and sits there.

*Endoprostheses***.** One of subtypes of endoprosthesing is the joint implanting. This is needed when your own joints can't make their work of moving the part of your body. The endoprosthetics implanting is used due to various diseases and injuries of the articular apparatus, which have led to a loss of motor functions. Metal endoprostheses are made from various stainless steel alloys. They are fixed to the bone using a special cement, which is acrylic resin and alloys of cobalt and chromium. For the manufacture of sliding components of endoprostheses, for example, the head of the humerus or femur, titanium alloys are used. And for the manufacture of sliding surfaces, heavy-duty polyethylene and alumina ceramics are

used. Due to the good quality of used materials implant's service life is on average 15-20 years, and in many cases patients use them for up to 30 years. When the endoprosthesis is worn out, it is replaced with a new one.

Neuroimplants. The first artificial silicon chip was created in 2003. Silicon has the ability to connect inanimate matter with living neurons, and transistors surrounded by neurons receive signals from nerve cells, while capacitors send signals to them. Each transistor on the chip picks up the slightest, barely noticeable change in electrical charge, which occurs when a neuron is "fired" during the transfer of sodium ions. The new microcircuit is able to receive impulses from 16 thousand brain neurons of biological origin and send back signals to several hundred cells. Since neurons were isolated from the surrounding glial cells during the production of the chip, proteins had to be added that "glue" the neurons in the brain, also forming additional sodium channels. Increasing the number of sodium channels increases the chances that ion transport is converted into electrical signals in the chip.

Cochlear implant. Cochlear implantation is a type of hearing aid that implies the implantation of a system of electrodes into the inner ear, which provides the perception of sound information through electrical stimulation of the auditory nerve. Cochlear implantation is the most effective, safe and reliable method of medical and pedagogical hearing and speech rehabilitation for adults and children with severe hearing impairment and deafness. A prerequisite for performing cochlear implantation is the preservation of the fibers of the auditory nerve, subcortical and cortical centers of hearing, as well as the patency of the cochlear passage. You need special equipment that allows you to accurately determine the level of damage to the auditory nerve [2].

Retina implant. Since the cochlear implant has made it possible to compensate for hearing loss in patients with hearing

loss at the end of the last century, it has become a motivation for research in the field of vision restoration. Since the visual system is much more complex, it was only by this time, thanks to the improvement of electronics, that it became possible to tackle this issue. Fundamentally different structures of the visual system can participate in artificial visual stimulation. However, since the processes in the brain are not well understood, systems at the retinal level currently have the greatest chances of success. It is known roughly which area of the retina needs to be stimulated in order for the resulting image to go further into the brain. At the same time, however, we cannot really predict what kind of visual perception will arise in general. For the introduction of visual stimuli into the retinal region, three different locations are possible: epiretinal, subretinal, and suprachoroidal, which have fundamental differences [3].

So, there exit many various kind of prostheses, each type performing particular functions and implementation mode. But all of them are intended to improve the life quality of any human being which needs a prosthesis.

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Virshich A., Vanik I.

FANUC as a Global Manufacturer of Industrial Robots

Belarusian National Technical University
Minsk, Belarus

Fanuc is a Japanese company, manufacturer of equipment for industrial automation which was founded in 1956. Today FANUC is the global leader in factory automation, providing high-tech products. The company name is an acronym for «Fuji Automation NUmerical Control» [1].

From its inception, when company founder Dr. Seiuemon Inaba first pioneered the concept of numerical control (NC), FANUC has been at the forefront of a worldwide manufacturing revolution. In Japan, FANUC had become the first company to build and operate an automated factory with NC machine tools and robots. With almost 60 years of experience in the development of computer numerical control equipment, more than 27,5 million products installed worldwide, FANUC is one of the leading global manufacturer of factory automation. With more than 100 models, FANUC offers the widest range of industrial robots in the world. Covering a diverse range of applications and industries, FANUC robots are easy to operate and provide complete flexibility thanks to a range of application-specific options, straightforward integration, payloads up to 2.3 t and maximum reaches up to 4.7 m [2]. Advanced and intelligent solutions have been applied to enhance motion, safety and productivity. One of these unique systems is FIELD system (FANUC Intelligent Edge Link & Drive). It is a FANUC developed Industrial IoT (Internet of Things) platform that allows manufacturers to connect production machines of different

generations from all manufacturers in a plant enabling comprehensive data analysis along the entire process chain [1].

The goal is to create a system that can be easily customized to flexibly respond to various automation needs, optimizing the effectivity and quality of the production process and improving predictive and preventative maintenance. FIELD system is backed by FANUC's worldwide Service and Support, making FIELD system the perfect choice as the backbone of a smart manufacturing strategy [1].

Today, in our fast-moving world, technology takes up a significant part of our lives. And of course, we cannot imagine it without robots. No production is complete without them. They make work faster, safer and cheaper. FANUC offers one of the broadest selections of industrial robots. All FANUC robots can be divided into collaborative robots, articulated robots, delta robots, palletizing robots, arc welding robots, top mount robots, paint robots, and SCARA Series [3].

A collaborative robot is a robot designed to work with humans and not to endanger a nearby worker. They always have special sensors to ensure its safety including optical, motion, and feedback sensors. Moreover, the software of such robots is focused on cooperation with humans. These robots do not get tired, which practically eliminates mistakes. Collaborative robots perform repetitive tasks with high precision. An example of a collaborative robot is CRX-10iA. Each manufacturing facility needs collection and placement. For example, collecting parts from a conveyor belt or laying them out for further operations. This robot has all necessary characteristics for this job. The CRX-10iA is highly protected against dust or oil leakages common in industrial environments. Because of its very low weight, the CRX can be easily installed in a broad range of applications such as automated guided vehicles (AGV). Its sensors are sensitive and

trigger an immediate safety stop at the touch of a human body [4].

Articulated robots are a whole family of articulated arm industrial robots designed for a wide variety of industrial applications including electric arc welding, packaging, picking, painting, and assembly operations. These robots are very compact that require very little installation space. At the same time, due to their well-thought-out design, they have a sufficiently large working radius and are distinguished by a high carrying capacity [5]. M-410 is one of them. It is the heavy-duty end-of-line palletizing specialist for loads weighing up to 700 kg! High wrist moments and inertia mean the M-410 can handle large grippers and heavy payloads at maximum speed. For better adaptability in handling different sized products, the M-410 can also be fitted with a servo hand that is controlled by the 6 axes servo. With models capable of handling anything from 110 to 700 kg payloads, whether it may be boxes, bags or slabs of concrete, there is a M-410 for every palletizing job [1]. Delta Robot is a kind of parallel robot. It consists of three levers attached to the base by means of cardan joints. The key feature is the use of parallelograms in the manipulator design, which allows maintaining the spatial orientation of the robot's actuator. One of the models of robots offered by FANUC is model M-3. M-3 robots are designed to maximize speed and versatility on high-speed small part handling and picking operations across a range of industries including food, pharmaceutical and electronics. Delta robots are especially popular in packaging lines, they are quite fast, some can handle up to 300 grips per minute [2]. Pallet robots is another kind of indispensable robots in production. These robots automatically pick up and place products on pallets. The equipment is used for storing goods in various packaging: paper boxes and packs, plastic and wooden boxes, cans, metal tanks. The palletizing robot is capable for stacking open and

closed top containers, boxes for exhibitions and other types of products. Such automatic systems are used in warehouses, logistics centers, exhibition pavilions.

Thus, we have considered the most popular models of robots that the company produces. For any job, FANUC can offer the right robot and there is certainly not a production operation that the robots of this company cannot do. Every year it introduces more and more modern technologies and improves her robots. And of course, none of this would have happened without people. FANUC strives to welcome young and ambitious people to its team.

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Demidovich V., Vanik I.

KUKA Automation Solutions

Belarusian National Technical University
Minsk, Belarus

Robotics is an interdisciplinary field that integrates computer science and a number of engineering fields like mechanical and electrical engineering, mechatronics, bioengineering, and others. Robotics develops machines that can substitute for humans and replicate human actions. The most widespread application of robots is manufacturing. One of the leading suppliers of intelligent automation solutions is KUKA AG, a German manufacturer.

The history of KUKA starts in 1898 with Johann Joseph Keller and Jacob Knappich in Augsburg. They founded an acetylene gas plant in Augsburg, thus allowing cost-effective operation of domestic and street lightning. The company name, KUKA, is an acronym for "Keller und Knappich Augsburg" [1]. In the 20th century KUKA begins market expansion in other areas. The product range is extended beyond welding systems and large containers. In the early 70-s Europe's first robot-operated welding transfer line was built by KUKA for Daimler-Benz. KUKA also wrote its history as a robotics pioneer with the world's first industrial robot with six electric motor-driven axes. Today, the KUKA Robotics Corporation continues to grow and applies its expertise in the logistics and healthcare sectors [1].

Flexible manufacturing in variable batch sizes with utmost efficiency is the challenge for the production of the future. To meet it, perfect human-machine interaction will be required. Robots and humans work hand in hand. Processes

and data are digitally accessible to everybody. The Internet of Things (IoT) has arrived in industry, and the digitization is well advanced. With its products and digital services, KUKA provides the companies with the benefits of Industry 4.0.

Alongside conventional industrial robots, collaborative, sensitive robots (cobots) can work together with production workers even more directly and precisely, facilitating their workload. With the integrated sensors, cobots make it possible to automate delicate assembly tasks ranging from automotive transmissions to handling flexible parts. People and robots work safely together and share the same workspace without any concerns. The "robot colleague" is a reality at KUKA [2].

Cobots play a crucial role in Industry 4.0. On the one hand, they are part of modern production. On the other hand, they collect data which forward all relevant information to the IT systems in real time. These immediately process the information and feed it back to production. Hence, companies are gradually optimizing manufacturing [2].

With the cobot KUKA LBR iiwa workers can perform their tasks more efficiently, more accurately, more focused. Thanks to its joint torque sensors LBR iiwa can detect contact immediately and reduces its level of force and speed. It can also find small, delicate components in next to no time without assistance. The LBR iiwa's controller allows it to simplify the quick start-up of complex applications. Monotonous tasks are performed reliably and independently. Areas of application range from assembly or adhesive bonding processes in industrial production to applications in medical or service sectors [2].

For example, thanks to KUKA's HRC expertise, Ford Company is already several ideas ahead with the automation of its production lines. On the headlight system test stands for the Ford Focus, for instance, two KUKA LBR iiwa robots perform the ergonomically unfavorable fine adjustments of the fog

lights while the operator adjusts the conventional headlights. Humans and robots work on the same vehicle without additional robotic safety equipment. As well as facilitating the workload of the worker, they also achieve greater adjustment quality and valuable time savings [3].

One more car maker that benefits from KUKA automation solutions is BMW Group's Dingolfing Plant. Today the employees work together with their collaborative colleague: an LBR iiwa lightweight robot from KUKA. With the HRC solution developed specifically for the customer, KUKA enables the car manufacturer to automate hard production steps previously carried out manually and ease the workload [3]. Thus, the KUKA contribution to the factory automation is, obviously, great. The company occupies one of the leading positions in export of industrial robots and solutions for factory automation. Large companies as Boeing, Space X, BMW, Ford and others are partners of KUKA. This confirms the quality of the company's products.

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Fedorovsky D., Vanik I.

How the Large Hadron Collider Works

Belarusian National Technical University
Minsk, Belarus

Large Hadron Collider (LHC) is the world's most powerful particle accelerator. The LHC was constructed by the European Organization for Nuclear Research (CERN)). This machine deserves to be labelled 'large', it not only weighs more than 38,000 tonnes, but runs for 27 km in a circular tunnel located 50–175 meters below ground, on the border between France and Switzerland. The LHC was shut down several times. In February 2013 it was shut down to fix the problem with the design of a superconducting wire. The second long shut down, during which the LHC's equipment would be upgraded, began in December 2018 and is scheduled to end in late 2021 or early 2022 [1]. In an attempt to understand our universe, including how it works and its actual structure, scientists proposed a theory called the Standard Model. This theory tries to define and explain the fundamental particles that make the universe what it is. It combines elements from Einstein's theory of relativity with quantum theory.

The Standard Model makes several predictions about the universe, many of which seem to be true according to various experiments. But there are other aspects of the model that remain unproven. One of those is a theoretical particle called the Higgs boson particle. The Higgs boson particle may answer questions about mass. Why does matter have mass? Some scientists hope the events created by the LHC will also uncover evidence for the existence of the Higgs boson particle. Others

hope that the events will provide hints of new information we haven't even considered yet.

Another question that scientists have about matter deals with early conditions in the universe. During the earliest moments of the universe, matter and energy were coupled. Just after matter and energy separated, particles of matter and antimatter annihilated each other. Fortunately, there was a bit more matter than antimatter in the universe. Scientists hope that they'll be able to observe antimatter during LHC events. [2]. One goal of the LHC project is to understand the fundamental structure of matter by re-creating the extreme conditions that occurred in the first few moments of the universe according to the big-bang model. In the 1960s British physicist Peter Higgs postulated a particle that had interacted with other particles at the beginning of time to provide them with their mass. The Higgs boson had never been observed—it should be produced only by collisions in an energy range not available for experiments before the LHC [1].

After a year of observing collisions at the LHC, scientists there announced in 2012 that they had detected an interesting signal that was likely from a Higgs boson with a mass of about 126 gigaelectron volts (billion electron volts). Further data definitively confirm those observations as that of the Higgs boson. Second, the standard model requires some arbitrary assumptions, which some physicists have suggested may be resolved by postulating a further class of supersymmetric particles; these might be produced by the extreme energies of the LHC. Finally, examination of asymmetries between particles and their antiparticles may provide a clue to another mystery: the imbalance between matter and antimatter in the universe [1].

The LHC is truly global in scope because the LHC project is supported by an enormous international community of scientists and engineers. Working in multinational teams all

over the world, they are building and testing equipment and software, participating in experiments and analyzing data. The UK has a major role in the project and has scientists and engineers working on all the main experiments [3].

The principle behind the LHC is pretty simple. First, you fire two beams of particles along two pathways, one going clockwise and the other going counterclockwise. You accelerate both beams to near the speed of light. Then, you direct both beams toward each other and watch what happens. The equipment necessary to achieve that goal is far more complex. The LHC is just one part of the overall CERN particle accelerator facility. Before any protons or ions enter the LHC, they've already gone through a series of steps [2].

With 15 petabytes of data gathered by the LHC detectors every year, scientists have an enormous task ahead of them. CERN's solution to this problem is the LHC Computing Grid. The grid is a network of computers, each of which can analyze a chunk of data on its own. Once a computer completes its analysis, it can send the findings on to a centralized computer and accept a new chunk of data. As long as scientists can divide the data up into chunks, the system works well.

One challenge with such a large network is data security. CERN determined that the network couldn't rely on firewalls because of the amount of data traffic on the system. Instead, the system relies on identification and authorization procedures to prevent unauthorized access to LHC data [2].

So, researchers have used the LHC to find the Higgs Boson. The discovery of the Higgs Boson is just the beginning. Researchers hope to find other types of bosons and other elementary particles and to use the LHC to begin testing the theory of supersymmetry.

The LHC is also scheduled to receive an upgrade to high luminosity somewhere after 2022, which will increase the spectrum within which results are visible. In simple terms, this

means researchers will be able to observe tests better, as the tunnels will be better lit [4].

This is important for obvious reasons, but the main concern is the LHC may be running out of potential discoveries given its current luminosity. In the early life of a collider, the number of discoveries is vastly greater than later on, as the number of things which can be seen at a given luminosity is finite. The only way to increase the number of potential discoveries is to upgrade the facility's luminosity or the strength of its instruments. The upgrade should allow for even more puzzling aspects of particle physics to be examined [4].

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Pautsina M., Borovaya P., Pyanskaya K., Ladutska N.
Strategic Planning in Logistics

Belarusian National Technical University
Minsk, Belarus

Most people, when they think about logistics, think about components such as warehousing and transportation. While these things are some of the main elements of the supply chain, it is important to look at the big picture - to develop an overarching logistics strategy. It can be said that this is the only way a company can ensure a high level of business efficiency in the supply chain.

Strategic planning is a set of actions and decisions taken by management that lead to the development of specific strategies designed to help the organization achieve its goals. Strategic planning is one of the components of strategic management, which, in addition to strategic planning, contains a mechanism for implementing decisions.

The strategic planning process includes four main types of management activities: distribution of strategic resources, adaptation of activities and management to changes in the external environment, internal coordination of work and awareness of organizational strategies.

Planning is necessary for a firm to achieve the following goals:

- increasing the controlled aggregate of the market;
- anticipation of consumer requirements;
- production of higher quality products;
- ensuring agreed delivery times;
- setting prices taking into account the level of competition;

– maintaining the reputation of the company with consumers [1].

There are four types of strategic planning: long-term, medium-term, short-term, and operational. Long-term plans reflect long-term goals and a general strategy of action for a period of 5 to 10 years. Medium-term planning is based on the real demand for the organization's products, changes in its characteristics in the near future, restructuring of production technology, financial constraints, market conditions, the risk of losing a partner, and they are developed for a period of 1 to 5 years. Short-term planning covers a period of several weeks or months. It is aimed at regulating the current use of resources and is implemented through the preparation of calendar programs for production and control over it, management of inventories and received loans. The task of operational planning includes control over the daily load of equipment, the sequence of operations, the placement of workers, etc.

Strategic planning provides important advantages in organizing the future activities of the company, including:

– prepares the use of possible favorable conditions for the successful work of the company;

– allows you to comprehensively analyze emerging (including those expected in the future) problems and threats in the company's activities;

– increases the consistency of measures in the business process of the company to achieve the set goals;

– creates conditions for the development of strategic thinking and foresight in the company's management;

– contributes to the formation of an information base for effective business management in implementing the strategy and achieving goals;

– ensures a more reasonable and rational distribution of the company's resources and their concentration on the main areas of the company's success.

Strategic plan is a program of integrated actions to achieve the set goals. The strategic plan must be supported by extensive research and evidence. To compete effectively in today's business world, a firm must continually collect and analyze a wealth of information about the industry, market, competition and other factors [2].

In the process of strategic planning, specialists use five tools for analyzing the external environment, such as SWOT analysis, Porter's five forces analysis, PESTLE analysis, vision analysis, VRIO analysis [3].

Your logistics strategy should focus on keeping you connected to manufacturers, suppliers, customers, etc. Build in the appropriate technology and processes to effectively link your business to all stakeholders and mitigate the challenges of time and geography.

Find solutions that are flexible and configurable. Since the supply chain is always changing, it is important to find solutions that are flexible to your organization’s changing needs rather than solutions that will be a forced fit at best.

Use accurate data for decision making. With the current technology that is available, there is no excuse not to make decisions based on real-time, accurate data. Ensure that you have the necessary technology in place that provides accurate data and make decisions accordingly.

Adopt new technology strategically. When there is a new technology that will improve your operations, do not be afraid to adopt it. Innovations such as track and trace, truck scales, and 3D printing are all examples of technologies that could help give you an edge over your competition [4].

In the past few years, the Republic of Belarus has been discussing the directions of reforming the current system of strategic forecasting (planning), streamlining strategic documents, powers and competencies of the authorities authorized in this area. They are reflected in the draft Law of

the Republic of Belarus "On State Indicative Planning of Socio-Economic Development of the Republic of Belarus" (hereinafter – the Law, ISU), which is currently under discussion.

The main idea of the Law is to fully regulate the activities for the implementation of state strategic planning in one document, prescribing in it all the participants in this process and their powers, the mechanism of interaction, the types and content of the adopted documents, as well as the procedure for their development. In practice, the implementation of the draft Law should increase the consistency, predictability and efficiency of activities [5].

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Lubianko P., Bondzich S., Ladutska N.

Containers, Their History and Role in Globalization

Belarusian National Technical University
Minsk, Belarus

Sixty years ago, there was a revolution, unnoticed by everyone, that you had never even heard of. From Ireland's largest port, goods are shipped all over the world. But even more recently, in the first half of the 20th century, shipping around the world was a problem. Goods were loaded into bags, crates and barrels. All of this was moved by hand, rolled and lifted on a cargo ship. It was slow, expensive, and dangerous for the cargo. It was easy to damage or steal. But the bigger problem was that the ships were only at sea half the time and the rest of the time they were in port making no money. This is also one of the main reasons why everything foreign was so much more expensive.

But one man changed everything in 1956. Thanks to him we now have phones, cars, fresh fruits and vegetables, food and drink from all over the world. And it took one simple invention that changed the world. These are the containers.

Malcolm McLean was born in 1914 and grew up on a farm in North Carolina. After graduating from high school in 1931, he worked for several years to save enough money to buy a used truck. In 1934 he started his transportation business. Soon McLean expanded his transportation business and had five trucks under his belt. During a routine delivery of cotton bales in 1937 from North Carolina to New Jersey, McLean witnessed dockworkers loading and unloading loads that took hours upon hours. He reflected on what a waste of time and

money it was. From 1937 until the early 1950 McLean focused on his transportation business, which had more than 1,750 trucks and 37 shipping terminals. In fact, it was the fifth largest trucking business in all of America.

The Great Depression was coming to the end in the 1930s. Malcolm McLean, just a truck driver, is waiting his turn at the port for 24 hours, watching the loaders at work. And a simple thought comes to him: "What if the truck could be lifted onto the ship as a whole, without unloading individual boxes?" Just the trailer with the cargo without the cab or wheels. And not just one trailer, but dozens, hundreds of trailers.

It took him 20 years to save up money and pawn all his property and buy a World War II tanker. It was named Ideal X. That's where he tested his idea. And in 1956 there was an event that defined world globalization. A ship with 58 containers on board was departed from New York to Houston.

After arrival, the containers were loaded onto trucks and delivered to the recipients. While it used to cost $6 to load one ton of cargo, it now costs 16 cents. The unions, of course, were angry: for hundreds of years the loaders had earned honest money, and now they have simply been replaced by some cranes and containers [1].

Nowadays every port in the world is stocked with EVERGREEN and MAERSK containers. There are also special containers for bulk cargo with an airlock at the bottom and for liquids and gases in tank form. And in these refrigerated containers, fruit is brought from far away countries. The ships have special sockets for them. But on their own, metal boxes on large ships could not change the economy. It was intermodality that changed it.

Intermodality is the idea the whole shipping logistics is built. As soon as cargo arrives at a port, it is removed by

crane and immediately put on a train or truck without being unpacked or unloaded. All over the world, the same standard clamps are the same, just like on Lego cubes: put, clamp, take away [2]. Globalization began, and the size of ships began to grow at an insane rate. In 60 years, their tonnage increased 200 times.

If you put it upright - it will be higher than the skyscrapers of Moscow City. One of its engines is the size of a five-story house. How many containers do you think new ships can carry? 300? 500? 1000? About 21000 containers. And each one weighs like a tank. To unload and haul this stuff on the ground would require 50 trains two and a half kilometers long, or 10,000 trucks. "How many people do you think it takes to move 21,000 containers?" 200? 300? 1000? About 20 people. That's the captain, first, second and third mates, engineers, helmsmen, technicians and a cook and mate. The trick is that each of them can be replaced by another in case of illness or death. Of the entire crew, only the captain and his assistants know what they are carrying. But they know the weight and contents of the containers only from the documents. That is why most of the drugs, migrants and weapons are transported by sea, in containers. The crew of 20 people don't care what is inside each container. What matters to them is to deliver containers to their destination point [3].

Sometimes containers fall out into the ocean. But what about the storms? Yes, no matter how mighty the big container ships may seem, it would be an exaggeration to say that they are immune to storms. On 14 February 2020, the 346-metre giant Svendborg Maersk was caught in a storm in the stormy Bay of Biscay. As a result, 520 containers were lost. The total number of containers lost each year is not known precisely; estimates range from 2,000 to 10,000 per year. Neither shipping companies nor insurance companies are in any hurry

to share the real accounts, so as not to scare the customers, especially since we are talking about a tiny fraction of the 160 million containers that are transported by sea every year [4].

Container delivery is one of the most profitable and convenient, it allows transporting oversized cargo at an affordable price. Competent use of containers of the appropriate type in the technological process can significantly reduce transport costs. However, the apparent simplicity of container shipping requires the participation of qualified professionals who will take into account all the nuances for competent, safe and inexpensive delivery of goods.

Globalization began with one simple idea - the idea of using one metal box on the whole planet. That's how a simple metal box changed the world. Today, the experience of all countries is available to us. Traditions, opportunities, entertainment, products. The world has become a huge supermarket. Think about that the next time you read the country of origin on the label.

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Bugaeva D., Ladutska N.

The Issue of Transport and Environment

Belarusian National Technical University
Minsk, Belarus

Our life is getting faster and faster, and people want to be aware of everything. People prefer convenience and speed. After all, there's always very little time. People choose transport. It is difficult to imagine human civilization without a car today. In developed countries, it has become not only the main vehicle but also part of everyday life. The natural desire of a person for freedom of movement, the complication of functions in production activities and the service sector, finally, life itself in large cities, urban agglomerations — all this leads to an increase in individual cars and an increase in the volume of freight traffic. The level of motorization has long been one of the main indicators of the country's economic development, the quality of life of the population. At the same time, the concept of "motorization" includes a complex of technical means that provide traffic: car and road.

However, scientific and technological advances not only benefit people but also harm them. "You have to pay for everything," says ancient wisdom. Car fees are our health, our lives. This is the probability of traffic accidents, accidents. This is the inevitability of harm from environmental pollution by emissions of exhaust gases, transport noise, other physical impacts. They have to suffer all people, even those who never use a car. And not only people, animals, vegetation, that is, all nature. It creates these harmful effects on the environment, not the road, but the car and a number of substances that the car emits. The road protects the environment from the car. The

duty of the engineer, builder, operator is to make this protection more effective and cheaper [1].

Air pollution by automotive infrastructure is now considered the biggest health threat. Every year, air and atmospheric pollution cause 7 million deaths worldwide. Air pollution causes and exacerbates a number of diseases — from asthma to cancer, lung disease and heart disease. Transport is one of the most important sources of air pollution.

The problem of transport and the environment is paradoxical, as transport brings significant socio-economic benefits, but at the same time transport has a negative impact on environmental systems. This problem needs to be looked at from different sides, since transport has a number of positive and negative sides. The role of transport in the life of the planet, state and city is really important, because movement leads to progress.

The development of the country's transport system is one of the necessary conditions for the further structural reorganization of the economy, increasing the competitiveness of domestic goods and services in world markets, as well as integrating the country into a dynamically changing system of international relations. On the other hand, transport infrastructure has a significant negative impact on the environment, since transport is the main consumer of energy and burns most of the oil in the world [2].

In the transportation sector, road transport is the largest source of global warming. It is estimated that up to 10 billion meters of pollution sources arise worldwide every year. Emissions from burning petroleum products affect all animal species. However, transportation activities support the growing need for passenger and goods mobility. The growth of passenger and freight mobility has expanded the role of transportation as a source of pollutant emissions and their multiple impacts on the environment. Currently, the impact of

transportation on the environment is the most pressing problem of modern society.

The main sources of environmental pollution and consumers of energy resources include automobile transport and infrastructure of the motor transport complex. Polluting atmospheric emissions from automobiles are more than an order of magnitude greater than emissions from railroad vehicles. The exhaust gases of internal combustion engines contain more than 200 names of harmful substances and compounds, including carcinogenic ones. Petroleum products, products of wear of tires, brake pads, loose and dusty cargo, chlorides used as de-icers of road surfaces pollute roadside strips and water bodies.

Motor transport accounts for the greatest share (54%) of the global pollution balance, but this share varies from country to country, ranging from 13-30% to 60-80%. A total number of cars in the world has exceeded 500 million units. While driving 15,000 kilometres an average car burns 2 tons of fuel, about 26-30 tons of air, including 4-5 tons of oxygen which is 50 times more than human needs, at the same time it emits into the atmosphere: carbon monoxide - 700 kg/year, nitrogen dioxide - 40 kg/year, unburned hydrocarbons - 230 litres, solid substances - 2-5 kg/year [3].

The transport and road complex are an important component of the economy of the whole world. However, the functioning of transport is accompanied by a powerful negative impact on nature. The contribution of transport to its pollution should be assessed in comparison with other sectors of the economy for all components of ecosystems: the atmosphere, water, soil, plant and animal world. Transport is one of the main air pollutants. Its share of total emissions of pollutants into the atmosphere from stationary and mobile sources worldwide is about 70%, which is higher than the share of any of the industries. In my article, I have given all the examples

that motor vehicles are the most powerful source of environmental pollution, at the end I want to take stock of my work by responding to the tasks set out in the introduction. So, the number of cars in the world is increasing, although a third of the fleet is very worn out, and are subject to write-off. During the operation of engines, a large number of harmful substances are emitted into the environment, such as nitrogen, carbon monoxide, hydrocarbons, aldehydes, carbon black, sulphur compounds, lead. These problems will be exacerbated if they are not controlled in the most thorough manner. Before making a decision, careful analysis based on mathematical modelling methods is needed [2].

It is necessary to force the authorities to implement effective policies and sets of measures to solve environmental problems, including methods of administrative pressure for non-compliance with environmental standards by certain activities, the use of laws on civil offenses, for which environmental pollution is equated with a violation of public order, the use of penalties for dumping waste, the maintenance of a system of taxes and licenses for dumping waste.

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Vensko A., Kastsianevich D., Ladutska N.

The Impact of COVID-19 on Logistics

Belarusian National Technical University
Minsk, Belarus

The COVID-19 pandemic, which covered the world in late 2019, has changed not only the lives of many people, but also the situation in global and local markets. A significant reduction in production capacity due to the closure of borders between countries and the introduction of a self-isolation regime has occurred all over the world. The coronavirus pandemic has disrupted the usual links between manufacturers and consumers around the world and has brought major changes to the business of logistics companies. The spread of the coronavirus has dealt a serious blow to the global logistics and supply chain of raw materials and finished products. For example, major international organizations - the International Road Transport Union (ITU) and the International Federation of Transport Workers - have published an open letter to all governments requesting support for the transport industry in the context of the spread of COVID-19. The crisis caused an imbalance in cargo flows associated with changes in demand, the suspension of production and the restrictions imposed [1]. Major global logistics trends are:

1. Reduction of cargo traffic on a global and local scale. The reasons are obvious: the closure of the borders between countries, the mass closure of retail outlets, currency exchange rate growth, the isolation of the population, the decline in demand and purchasing power, as well as the state of fear and uncertainty among consumers.

2. The lack of simple, clear rules of the game in the conditions of quarantine for representatives of the logistics market.

The pandemic has significantly affected the logistics industry: demand, sustainability, transportation and warehousing, and working conditions [1]. In China, all types of transportation were affected: air, sea, rail, and road. The usual multimodal schemes were destroyed. Logistics companies had to urgently look for an alternative to the «broken» links. Due to logistics problems, the most affected party could be the automotive industry, where the supply chain between auto parts production sites and assembly plants was threatened. However, logistics congestion was overcome [3]. The customs services of the Chinese provinces are also working effectively in the conditions of the epidemic, which have significantly reduced the time for processing priority cargo, opened "green corridors" for anti-epidemic and medical cargo, as well as for raw materials and spare parts needed to restore production. Many customs offices have switched to the «first release – then the end of customs inspections» mode. It also helped to reopen businesses and normalize foreign trade.

As for the European Union, at the moment the economy suffers from all the consequences of quarantine measures. The movement of freight transport is not completely closed, but there are certain limitations. In addition, transport companies have significantly fewer customers. In general, experts predict a drop in the European cargo transportation market by at least 40%. Russian logistics companies are also going through hard times. According to InfraONE estimates, the losses of the infrastructure industries of the Russian Federation from the epidemic by 1st of May, 2020 amounted to approximately 507 billion rubles, of which almost 50% – 230.3 billion rubles – are losses of the transport industry. It is important to note the consequences of the epidemic, which affected each type of

transportation: the greatest losses have been incurred by the direction of international air transportation; the rail transport industry is experiencing a crisis, but there are also positive trends, e.g., most of the cargo flows are transferred to rail transport; in road transport, priority or «the green corridor» for entry to all countries is given to cargo transport with food and medical goods [2]. Quick adaptation to changing conditions will help logistics companies quickly "recover" after the crisis. It is obvious that even in the post-crisis period, the following trends will continue to affect the logistics industry around the world:

1) dumping in the logistics market. Increased competition for the customer leads to the emergence of price dumping in the cargo transportation market, as the number of goods decreases;

2) withdrawal of weak players from the market. In the near future, small and some medium-sized players will be forced to leave the logistics services market;

3) development of collaborations, cooperation, integration of services. Players will start joining communities to share each other's services;

4) increased demand for fleet repair and maintenance services. 90% of logistics companies refuse to upgrade their fleet due to the rising exchange rate and the pandemic;

5) introduction of the latest IT technologies. The IT revolution has begun in logistics. It is worth noting the use of IT platforms for logistics companies to exchange tariffs and rates;

6) contactless courier delivery. The winners will be those companies that can offer the safest way to deliver goods from the point of view of health;

7) development of parcel delivery by "drones". This trend came from Asia as a continuation of the idea of contactless delivery. During the pandemic in China, most packages were delivered door to door;

8) compliance with sanitary standards, disinfection of equipment, vehicles will become the norm and a requirement on the part of receivers [3].

Thus, due to the global crisis triggered by the COVID-19 pandemic, the logistics industry is in dire need of support. Quarantine measures taken to suppress the coronavirus epidemic have led to congestion at most airports and sea terminals and, as a result, violation of the terms and conditions of cargo delivery.

Overcoming the current crisis is an unprecedented challenge for the management team of all logistics players. After the pandemic, the logistics world will not be the same as before. COVID-19 will likely affect trade more profoundly than any other recent crisis. It will have a significant and lasting impact on the global economy, but trade volumes will recover. And the companies that follow trends and quickly adapt to changing circumstances will be able to manage the situation, create popular services and strengthen their position in the business. As the saying goes, «who owns the information, he owns the world» [2].

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Vidruk D., Ladutska N.

Evolution of Land Transport

Belarusian National Technical University
Minsk, Belarus

There is no doubt that necessity is the mother of invention, and all inventions and discoveries appear because of problems needed to be solved.

The automobile as we know it today was not invented in a single day by a single inventor. Many people or teams of people are credited with inventing the car.

It all started with the invention of the wheel in 4000-3500 BC. And it caused the appearance of the very first vehicle - a wheeled cart [3]. In medieval Europe, riding in a wheeled cart ceases to be prestigious for a noble person. The wheeled carriage is once again spreading among the upper classes of society in the Renaissance. In the XVI century, riding in carriages became fashionable. With the industrial revolution, the wheeled cart is gradually being replaced by new types of transport - rail, road, etc. In the Middle Ages, most of the discoveries were made in the field of maritime transport.

In 1662, the first public passenger transport route opened in Paris, which has a regular route, schedule and fare system. In 1672, Ferdinand Verbist built the first prototype car as a toy for the Chinese emperor. In the description of his toy, Verbist first mentioned the term "motor". The car was small in size and could not accommodate passengers, but it may have been the first working steam transport.

In 1769, the French inventor Cugnot tested the first model of a steam-powered machine, known as the «Cugnot small cart» and in 1770, the «Cugnot large cart». In 1789, the

American design engineer Oliver Evans received the first patent for an automobile in the United States, which is the first amphibious vehicle.

The first quite successful experiment in the construction and operation of a steam locomotive was conducted by R. Trevithick in 1803-1804. In 1808, to popularize his idea, Trevithick created an experimental attraction ring road in London, along which a steam locomotive moved at a speed of 15-20 miles/h. In 1815, the Czech mechanic I. Bozhek built a steam cart, which successfully passed the tests. It should be noted that experiments on the creation of such steam vehicles continued until the end of the XIX century. A very large contribution to the development of the idea of steam transport was made by D. Stephenson. On July 25, 1814, Stephenson tested his first steam locomotive, which carried a load of 30 tons at a speed of about 6 km/h. Some contribution to the development of steam transport was made by Murray, Blenkinsop, the Chapman brothers, Gaxworth, and others [2].

In the 18th and 19th centuries, many scientists and engineers contributed to the development of internal combustion engines. In 1791, John Barber invented the gas turbine. In 1794, Thomas Mead patented a gas engine. In the same year, Robert Street patented an internal combustion engine on liquid fuel and built a working prototype.

In 1799, the French engineer Philippe Lebon discovered lamp gas and obtained a patent for the use and method of producing lamp gas by dry distillation of wood or coal. In 1801, Lebon took out a patent for the design of a gas engine.

In 1807, the French engineer Nicephore Niepce launched an experimental solid-fuel internal combustion engine (fuel-powdered pyreolophore). And that year the French inventor Francois Isaac de Rivaz built the first piston engine. The engine ran on hydrogen gas, having structural elements that have since been included in subsequent ICE prototypes: a

piston group and spark ignition. There was no crank mechanism in the engine design yet. In 1860, an amateur engineer, Etienne Lenoir, created an internal combustion engine powered by lamp gas. In 1862-1863, a gas-generating power plant with a capacity of up to 4 hp was installed on an eight-seat open omnibus.

The first motorcycle with an internal combustion engine was created in 1885 in Germany by German engineers Gottlieb Daimler and Wilhelm Maybach. On August 29, 1885, Gottlieb Daimler received a patent for a «vehicle with a gas or kerosene engine». From 1886-1896 gasoline-powered vehicles were patented, tested and produced by Karl Benz and Gottlieb Daimler (a three-wheeled vehicle with a stationary internal combustion engine, the first "crew with a motor" by Benz, Daimler's "mobile", the world's first bus, the first truck with a diesel engine and etc.) Since 1925, MAN has been producing the world's first series of diesel trucks. A year later, MAN released the world's first three-axle 6-ton diesel truck, the S1H6. In 1936, the world's first production passenger car with a Mercedes-Benz 260D diesel engine appeared [4].

In 1940, Oldsmobile released a car with the world's first automatic hydro-mechanical transmission (Hydramatic). Since 1997, the Japanese Toyota Corporation began production of the world's first mass-produced hybrid passenger car, the Toyota Prius, which is powered by both gasoline and electric engines. Its Hybrid vehicle drivetrain is built in such a way that allows both the gasoline engine and the electric motor to be directly connected to the driving wheels of the car and interact with each other.

In the 21st century, more and more new technologies are being introduced into all spheres of people's lives, which is reflected in the automotive industry. In 2001, monitor buses were introduced. Ionistors are capacitors with a double electric layer, which, in comparison with batteries, have the ability to

receive and release energy extremely quickly, while maintaining high efficiency. In 2004, the Shanghai Maglev, the fastest commercial maglev railway line, was launched, connecting Shanghai Metro station Longyang Lu to Pudong International Airport. Nissan LEAF is an electric car of the Japanese Nissan concern, mass-produced since the spring of 2010 and built on the new Nissan V platform. In November 2013, the Toyota Mirai, a hydrogen hybrid fuel — cell car, was first introduced to the public at the Tokyo Motor Show.

Based on the obtained material, we can conclude that there have been great changes in the field of transport, the evolution of transport from a wheeled cart to hydrogen hybrid cars. This process does not stand still, so it is difficult to predict the next steps of improving vehicles.

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Muzychka P., Valasiuk D., Ladutska N.

Alternative Energy Sources Used in Transportation

Belarusian National Technical University
Minsk, Belarus

Logistics is the management of the flow of things between the point of origin and the point of consumption to meet the requirements of customers or corporations. Today people use a lot of transportation ways: road transportation, marine transportation, air transportation, rail transportation.

All types of transport have both their pros and cons, but there is one drawback that unites them, it is air pollution. All transport releases harmful CO2 into the atmosphere, which greatly harms humanity and our planet. However, there is already a solution, and this is transport on alternative energy sources.

Alternative energy sources are represented today by all sources of clean power that will successfully replace fossil fuels in the future for a cleaner environment. They are electric power, solar and wind energy, hydropower, biomass and geothermal energy, tidal power, etc.

Electric transport is a type of transport that uses electricity as a source of energy. Its main advantages over vehicles powered by external or internal combustion engines are higher performance and environmental friendliness.

Electric trucks have been around in niche application areas for over a hundred years, but the invention of lithium ion batteries has enabled the range of electric trucks to increase to several hundred miles. However, electric trucks are usually heavier than diesel trucks, the energy density of lithium ion batteries is far less, so very long-range trucking requires

recharging on the route, causing delays, or the swapping of trucks.

The diesel truck is using 3.37 times the amount of energy that the electric truck is using. Thus, the only variables that are stopping the commercial use of electric trucks are the original vehicle cost and the driving range, owing to the high battery pack cost and low specific energy. As mass production happens the cost might eventually be comparable to diesel vehicles and with improvement in batteries the limited range of the electric truck might be a non-issue.

Electric transport is represented not only by trucks but also by forklifts. Loaders can be attributed to one of the most demanded types of special equipment. This equipment is distinguished by its functionality and high speed of operation. That is why it is so often used in a wide variety of areas, including when organizing cargo transportation. In some cases, these forks are supplemented with the necessary additional devices: hooks, pallets [1].

Battery life is one of the biggest benefits of electric forklifts. Electric forklifts are very universal. They are also good for workers and the environment in many ways. Electric forklift trucks do not emit harmful emissions, making them ideal for indoor use. Workers breathe clean air and companies can cut ventilation costs. Electric forklifts are also quieter than gas ones. This makes them more secure. Warning signals and alarms can be heard more clearly. Workers do not suffer from ear fatigue. When your employees are not distracted by loud noises, the number of accidents can be significantly less. Other benefits of electric forklifts are stated as:

- the absence of a fuel tank which reduces the probability of a fire;
- better visibility (compared to trucks with rear-mounted liquid propane tanks);
- less maintenance;

- longer service life;
- fewer breakdowns due to fewer moving parts in the engine.

Like any equipment, electric forklift trucks have their drawbacks. Most of them have less power and load capacity than gas analogues. The batteries can be charged for up to eight hours, which can lead to downtime if a spare battery is not available. Charging stations take up space that can be used for other purposes. Electrics are easily damaged by weather such as rain or snow. Despite all the problems with electric forklifts, most users will say that the pros far outweigh the cons.

Opinions are divided over the prospects for electricity as a source of energy for trucks. Some say that the direction will not lead to any result, others bring to the market a lot of proposals on this issue. Here we are talking about cargo transportation over short distances. But what about long distances? You can answer this question if you think about it and look into the future. Most suitable for long distances is hydrogen. Here you can build on the intentions of Daimler, which plans to start producing trucks on liquid hydrogen in the second half of the 2020s. Also, Daimler, together with Volvo, signed an agreement on the development of hydrogen transport technology [2].

One of the main obstacles to the implementation of this technology is the cost of hydrogen production, which is high today. In addition, it is necessary to invest in the construction of hydrogen filling stations. For example, in Switzerland, hydrogen trucks are already in use and they have good prospects [3]. Biofuels (methane, ethanol, rapeseed oil, etc.) are, according to experts, the most promising alternative to gasoline today. Work on its implementation in full or in a mixture with gasoline is very actively carried out all over the world. Environmentally, it is not a panacea, but better than gasoline, it is a renewable source. In many countries of the world, biofuels are made from industrial waste: in Cuba

ethanol is obtained from waste from sugar cane processing, in Hong Kong methane is obtained directly from rotting waste in landfills by pumping this gas from the voids of garbage dumps. In addition, advances in biology and genetic engineering allow us to count on a significant breakthrough in this matter in the near future [2].

Nowadays, everyone makes a choice for themselves - a choice between electrocars and biofuels. Each has pros and cons. But, at the same time, an individual approach is needed here. It is necessary to evaluate routes, traffic frequency, etc.

From all of the above, we can conclude that in the near future transport on alternative energy sources will increasingly enter our lives, especially over short distances. Assessing the needs of carriers in various niches, we can say that just one solution will not be enough for everyone. The energy demand on the planet is still covered mostly from fossil resources, but renewable energy projects are increasing their presence in many countries, which shows that the clean future is closer than we thought.

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Gaikova V., Filimonova K., Ladutska N.

Digital Twins in Logistics

Belarusian National Technical University
Minsk, Belarus

In the modern world, there are more and more new technologies that are gradually being introduced into various areas of production, and logistics is no exception. Manual processing of information is replaced by a computer, in the world, there are automated systems that make it possible to simplify the process of work in enterprises. With the use of these technologies, production processes are optimized, the data processing time is reduced and the efficiency of enterprises is increased. One of such technologies is digital twin technology [1].

A digital twin is a representation of a physical object, process or service, such as a jet engine or wind farms, or even larger items such as buildings, or even whole cities and supply chains.

The digital twin technology using for copying processes to help a company to predict how these processes will perform. These programs can integrate the internet of things, artificial intelligence and software analytics to improve the results.

With the progress of machine learning and factors such as big data, these virtual models have become a big step in modern engineering to drive innovation and improve performance [2].

Creating a digital twin can allow avoiding costly failures in physical objects, by using advanced analytical, test processes and services, monitoring and predictive capabilities.

The lifecycle of a digital twin starts with experts in applied mathematics, data science researching the physics and operational data of a physical object to develop a mathematical model that simulates the original.

The developers who create digital twins have a warranty that the virtual computer model can get feedback from sensors that gather information from the real world version. This lets the digital version simulate what is happening with the original version in real time, creating opportunities to collect insights into performance and any other potential problems.

A digital twin can be as complex or as simple, with differing amounts of data determining how clearly the model simulates the real world physical object [5].

The twin can be used with a prototype to offer feedback on the product as it can even act as a prototype in its own right to model what could happen with a physical object when built.

Since it can be used across a wide range of industries, from healthcare to automotive and power generation, it has already been used to solve a large number of problems. A digital twin allows users to explore solutions for product lifecycle increase, manufacturing and process improvements, and product development and prototype testing. The digital twin can virtually show a problem so that a solution can be invented and tested in the program rather than in the real world.

Digital twins help companies to solve problems by simulating all assets in a complex supply chain. A company can make decision across multiple planning horizons:

–short-term planning and realization;

–sales and operations planning;

–longer-term planning.

Designing, monitoring, and managing packaging and containers create a number of challenges for the industry. The growth of e-commerce such as packaging variety and driving up demand. This produces significant reduces operational

efficiency through poor volume utilization. The application of material digital twins could help the development of better and more environmentally friendly packaging materials. In efforts to improve stability, companies are exploring the application of a range of new materials including compostable plastics and materials with a high percentage of post-consumer recycled content. Material digital twins could help companies understand and forecast the performance of new materials in packaging applications, could model material behavior under the temperature, vibration, and shock loads experienced in transit [4].

Digital twins could also help logistics participants manage container fleets more efficiently. Reusable containers are an industry standard in multiple logistics flows. They include standard ocean containers, reusable crates to transport car parts between factories, and containers for food and drinks delivery to retail stores and consumer homes.

Nowadays, the engineering, manufacturing, energy, and automotive industries are leading the way in impact digital twins to manage their most critical assets, followed by healthcare, logistics and even supply chain. As the necessary technologies continue to become more available, the logistics sector is only just now beginning its digital twin way and early examples of the first supply chain facilities using digital twins are beginning to appear. Perhaps more important for logistics professionals to consider in the near term is not how to use digital twins for direct management of supply chain operations, assets, and facilities but rather how to develop the supply chain [3].

For digital twins and their physical twins to work together optimally, there is an increasing need for logistics professionals to improve sensitivity, service quality, availability, and delivery accuracy to ensure the thing performs in optimal harmony with its intended design and performance.

The most successful retailers are those that are already recognizing and implementing technologies such as digital twins, artificial intelligence and machine learning – they are the ones that are staying ahead of the curve in tough times. If businesses are to survive and thrive in the new normal, they must implement the right enabling technology that will help them gain insights into their supply chains and make them more agile to respond to rapidly changing conditions [6].

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Gromak E., Ladutska N.

Passenger Transport of the Future

Belarusian National Technical University
Minsk, Belarus

Currently, there is a smooth transition from the traditional structure of the economy to the digital one. To ensure this transition, technologies are needed that will help make this transition, as well as optimize and automate various processes in the sectors of the economy. One of the directions for improving the work of transport is digital transformation in the field of passenger transportation: the creation and implementation of automated dispatching systems, payment and travel control, as well as information support of the transportation process. Automated systems operating in passenger transport in the Republic of Belarus do not fully eliminate the problems of the lack of objective accounting of transport work, inconsistency of timetables for various types of transport, the introduction of modern and progressive payment methods, increasing the efficiency of passenger traffic, do not interact sufficiently with each other and with related systems, and in some cases are completely autonomous. Under the influence of digital transformation, new modes of transport will completely replace existing ones, radically changing the transport sector of the economy and causing a change in passenger traffic. Now a new era is dawning in land transport. News about the passenger transport of the future seems like quotes from science fiction novels. But if we do not forget about the speed of progress, then, probably already in 2030, the transport of the future will come to all megacities of the world [1].

Another goal of inventors in the transport industry is to save energy and improve the ecology of cities. This can be achieved by eliminating hydrocarbon fuels and switching buses to electricity and biofuels. The problem of safety in the transportation of passengers (as you know, 90% of accidents on the roads occur due to the fault of the driver) can be solved with the help of unmanned transport technologies, which are already being implemented by companies such as Google, Uber and Tesla. Traffic jams and congestion in large cities remain another global problem. New transport systems should help here, allowing passengers to move over city traffic on dedicated lines. In addition, technology companies can solve this problem by developing new models of flying taxis in their laboratories [1]. Developers of technologies for the transport of the future set themselves several challenges that correspond to the pressing problems of the industry. One of them is reducing the time for passenger transportation. New solutions to save passenger time are traditionally offered by designers of high-speed trains. Engineers from Japan, South Korea, France and other countries continue to work on technologies in this area. An alternative to such developments can be the Hyperloop vacuum train technology developed by the American entrepreneur Elon Musk - according to the project, the train moves with an air cushion inside a tube. In August 2013, Elon Musk presented the concept of the bullet transport of the future - the vacuum train and the Hyperloop highway. Inside the steel pipe, transport capsules will move on air cushions, each accommodating up to 28 people. The speed roughly corresponds to the speed of sound in the air - 1200 km/h. The pipe will be supported by columns, and electricity will be provided by solar panels installed across the entire area of the airway. Elon says it requires 21 megawatts to operate, and the panels can generate 57 megawatts on a sunny day. Thus, if capsules are sent from the station every half a minute, 7.4

million people a year can get from San Francisco to Los Angeles (600 km) in less than half an hour. According to Musk's calculations, the project will pay off in 20 years. Many countries are converting public transport to electric motors to reduce noise and smog in metropolitan areas. The Republic of Belarus is among them. Currently, Belarus is developing a comprehensive program to convert all public transport in large cities to electric one. We are talking about 100% replacement of trolleybuses and traditional buses with electric transport - electric buses. The transition is expected to be completed by 2025. Buses and trolleybuses will slowly make room due to the more active use of electric energy. It has been proven that such a transition not only reduces the environmental burden, but also increases the overall energy efficiency of the entire transport sector. Electric buses can be either static charging or dynamic charging. The latter are outwardly similar to trolleybuses and can operate from the city network, but in parallel with this, the battery is being charged, which allows it to work autonomously. Therefore, the route of such transport must necessarily include streets equipped with trolleybus lines. Computer-controlled cars and buses (unmanned public transport) will help reduce the number of accidents and solve the problem of congestion. In Europe, such vehicles are being developed and tested. The first foreign experience belongs to the Cognitive Technologies company. In February 2015, she, together with KamAZ, developed a project for an unmanned truck and tested it. The unmanned bus «Matrëshka» can carry passengers and goods and work as a municipal vehicle. «Matrëshka» powered by electricity, the battery lasts for 130 km. A full charge takes four hours. The technical speed of the bus exceeds 100 km/h, but the unmanned speed was limited to 20 km/h [2].

«Shuttle» (KamAZ). The maximum speed is 40 km/h. It can deliver passengers to predetermined stops that are loaded

into the electronic system. The passenger can control the door opening system, the system for selecting the stopping point for disembarkation, stop on demand, emergency stop, call for help, manual door opening. The body is made of composite, the frame is made using aluminum materials. The introduction of driverless cars requires new legislation as well as the creation of detailed road maps. It is better to put data on the restrictions in force on the road and nearby objects in the program in advance: this will save the drone from erroneous recognition of objects and, accordingly, from accidents. Based on the foregoing, it can be concluded that digitalization of various spheres of economic activity is becoming a priority issue for the successful development and functioning of an enterprise and the state in the international arena, because if the state is unable to carry out reforms and modernization of the economic sphere, then there is a high probability that it will not be able to withstand competition with other states that have successfully overcome the digitalization of the economic sphere, which in the future will lead to adverse economic consequences and, possibly, a protracted economic crisis [2].

The introduction and development of digital technologies in the transportation process in the future will have a positive effect on the quality of transport services, the convenience of providing transport services for passengers, as well as improving the services provided.

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Kos V., Kutsen D., Luchko M., Ladutska N.

Logistics and Marketing in Business

Belarusian National Technical University
Minsk, Belarus

Logistics is the science of planning, organizing, managing and controlling the movement of material and information flows in production and in time from their primary source to the final consumer. The goal of logistics is to have the right products in the right place, in the right quantity, at the right time.

Marketing is a type of business activity aimed at meeting needs and demands through exchange. The founder of the marketing theory is Philip Kotler.

Both concepts clearly emphasize the role of consumers rather than producers [1].

According to the goals and tasks being solved, logistics and marketing, in essence, are parts of a single process - the process of meeting consumer needs. Marketing and logistics are inseparable from each other, since in the aggregate they determine the policy and nature of the production, supply and sales activities of the subjects of market relations.

At the initial stage of the formation of a logistics system, the goals of logistics often come into conflict with the goals of marketing. For example, a reduction in stocks of finished goods is not always acceptable for marketing services, as sales losses may occur in the event of increased demand and lack of inventory.

The logistics system interacts with many management functions. Marketing requirements directly affect the cost performance of logistics in a business.

Marketing determines the assortment specialization of production, and the larger the range of products, the more complex the logistics problems in the field of production support, order processing, inventory management, transportation. The introduction of a new type of product into production usually leads to an increase in physical distribution costs.

The effectiveness of the marketing service largely depends on the general state of the economic organization management and its constituent parts, in particular, on logistics. Recognition of the need for interaction between logistics and marketing is characteristic of many modern economists.

Discussion of questions about the relationship between marketing and logistics in the scientific literature has led to the emergence of different points of view:

- logistics is an integral part of marketing;
- marketing is an integral part of logistics.

However, in the course of various operating principles studies, it was found that logistics and marketing cannot be part of each other, because their goals do not coincide. Profits cannot be part of costs, and costs are not part of profits. Logistics and marketing use too different techniques in their activities, and their strategies have little in common. But the consideration of these services independently of each other is unjustified, since they constantly get in touch in work, and each for the other creates conditions for effective activity.

The interaction of marketing and logistics is considered in modern management within the framework of the supply chain management system - SCM (Supply Chain Management).

The closest interaction of logistics and marketing is necessary when developing and implementing corporate strategies aimed at expanding sales markets or significantly

increasing sales. In this case, the alliance of marketing and logistics can allow not only to increase the competitiveness of the company but also to ensure the implementation of corporate tasks with minimal investment.

The modern marketing concept distinguishes four main complex functions:

- market research and collection of information;
- development and planning of the range of products;
- organization of commodity circulation and sales;
- advertising and sales promotion [1].

If one analyzes the performance of these functions with an open mind, it turns out that they cannot be completely effectively implemented without the participation of logistics services.

The first function sets the parameters for the logistics system and marketing strategy. However, the organization of effective management of information flows, the creation of a progressive information support system.

The relationship between marketing and logistics is quite closely carried out within the framework of the second function. Marketing predetermines subject specialization and assortment structure of production, which affects the formation and further development of the logistics system. However, later on, logistics has the opposite effect on marketing [2].

The third marketing function - the product promotion organization and sales - is most closely related to logistics. The processes of physical movement and, in general, the management of material and information flows for logistic purposes, identifying marketing distribution channels, allow an enterprise to realize itself as a subject of market relations.

The implementation of the fourth marketing function is also characterized by integration with logistics. Advertising of goods by means of vehicles is considered to be very effective, and manipulation of terms of delivery and tariffs for

transportation has always been and remains the strongest lever of sales promotion.

Thus, we can conclude that logistics and marketing are two equal concepts with a single field of functional application, common ultimate goals, but different tools and subject of interest.

Below some general marketing and logistics concepts are stated. The common costs concept is designed to ensure joint decisions in the form of a systematic approach to reducing costs in supply chains and distribution channels.

Business process reengineering concept. The main provisions of this concept are as follows: the study of consumer requirements for the final product.

The integrated activities concept in logistics and marketing involves the implementation of a number of tasks: accounting and meeting consumer requests, delivering products on time, analyzing production failures, and etc.

The concept of a full cycle in logistics and marketing is based on the logistics concept of managing a complete supply chain. The concept of a full cycle in logistics and marketing, combining logistics and marketing activities, covers all areas of commodity movement in the complete supply chain [2].

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Kukharchuk A., Grishchuk P., Ladutska N.

Green Logistics

Belarusian National Technical University
Minsk, Belarus

In the modern world the concept of logistics is interpreted as science of management and optimization of material flows, service flows, information and financial flows in a particular micro -, meso - or macro-economic system to achieve its goals. It does not stand still and constantly requires development, as our world is also developing: new technologies, new problems are appearing constantly. Every day the planet's ecology suffers from human activities. The logistics sector is involved in the increase in the level of carbon dioxide. Its share in the emission of this gas is about 15%.

Large enterprises understand the scale of the problem and try to fight against it. Green logistics appeared to solve problems with the environment. Green logistics can be defined as activities aimed at identifying and measuring the negative impact on the environment in the process of bringing goods to the customers, as well as research that are carried out to find ways to reduce this negative impact [1].

«Environmental logistics (ecologistics)» is a synonym for the term «Green logistics». The emergence of this kind of logistics was due to many factors, the most significant of which are:

– construction of logistics infrastructure facilities, that is accompanied by massive deforestation, damage to the topsoil and groundwater ecosystems;

– the use of outdated methods of organizing production processes contributes to the pollution of air, water and soil with harmful waste;

– the use of vehicles that do not meet modern requirements has a noise and vibration effect [2].

The founding principle of Environmental Logistics is to promote the benefits of reuse and recycling whenever possible and to provide for cost efficient and environmentally responsible alternatives for the management of hazardous wastes.

Some global companies that intend to become «green» and socially responsible face a number of difficulties on their way, because environmental logistics in some countries is just in the early stages of its development. These difficulties are:

– high level of costs;

– low level of market supply;

– lack of experience in applying the principles of «green» logistics in some countries of the world;

– a significant shortage of experts in this field.

In that way, we can say that "green" logistics is quite unprofitable, since several times it takes more time and costs than ordinary logistics. But in this situation companies have to choose: either a fast and high-quality logistics service or the same logistics service with slightly higher costs, but not harmful to the environment.

Nevertheless, in the modern world, most companies choose «green» logistics. If at the enterprise the production and packaging waste is minimized, and the ideas of recycling are applied, which will remove the share of costs from consumers of finished products, then such an enterprise can be attributed to those who effectively use their resources.

Therefore, five factors affecting the level of environmental sustainability in logistics can be distinguished.

1. *Natural resources*. Each year humans use 30% more natural resources than the planet can replenish. This leads to deforestation, degraded soils, polluted air and water. To be sustainable more emphasis is being laid on using natural resources less and more efficient, and shifting focus to more renewable resources where possible.

2. *Energy consumption* can be defined as the net fuel-energy that is needed to provide the heat and power requirements for a production process. The inputs of these processes include natural gas, fuel oil, steam and electricity.

3. *Water consumption*. This can be the evaporation and misting losses from cooling water, water vapor vented to the atmosphere, water lost through waste treatment or disposal, and other water losses.

4. *(Greenhouse) gas emissions*. Emissions can be divided in two parts: toxic emissions and pollutant emissions. Toxic emissions come from chemicals that are listed by governmental institutions and should be reported to state authorities. Pollutant emissions in some way influence the environment, but are not toxic by definition. They lead to air acidification, water eutrophication, ozone depletion, acidification of fresh water, and salinity in freshwater.

5. *Waste generation* can be defined as the amount of materials not converted to the desirable product.

Logistics buildings such as distribution centers and transportation facilities also have a number of aspects that affect the environment:

1. Internal transport and emissions;
2. Energy consumption of facilities;
3. Emissions of transport units to or from facilities;
4. Congestion around facilities.

Rationalization of the packaging process also plays a significant role in the development of green logistics. Usually packaging represents 23% of all waste weight and 37% of all

waste volume. The use of recyclable or biodegradable material for packaging is a way to decrease the strains on the environment. The aim should also be on using fewer packaging materials as well. Sustainable packaging can reduce the carbon footprint of the whole supply chain and the elimination of packaging can lead to an overall cost reduction [3].

It can be concluded that green logistics is one of the main sources of not only environmental care, but also cost minimization and extracting additional profits from the processing of materials for their secondary use. Based on the current environmental situation in the world we can state that there is a need to find more environmentally friendly ways of transporting, storing and packaging goods. The application of green logistics is necessary, because the social responsibility of business is extremely important.

Finally, green logistics and environmental sustainability in the supply chain will become even more important in the future than they are already nowadays and they should be a focus of every company around the world.

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Mironenko N., Ladutska N.

Transport Logistics of the Republic of Belarus

Belarusian National Technical University
Minsk, Belarus

Transport logistics is a system of organizing the movement of various goods from the starting point to the final one, having determined the most optimal route of movement. This route provides for the shortest delivery time, with minimal financial costs and danger for the cargo. Any transport company pays great attention to such a system, since the costs of moving goods are significant and affect the bottom line. Transport logistics plays a key role, associated not only with the large share of transport costs of the total logistics costs but also due to the fact that it is impossible to advance the material flow without transportation.

Today a logistics expert doesn't only plan effective cargo transportation but also deals with packaging and warehousing of products, marketing transportation. Besides, he develops a reliable and stable transportation scheme and solves different problems that arise during transportation.

For the Republic of Belarus, located at the crossroads of major transport routes and connecting Western Europe with the countries of the East, the problem of compliance with general global trends and strengthening its position in the market of transport and logistics services as the most important logistics sector is becoming more and more urgent.

For objective reasons of a historical, political, economic nature, there is a certain technological lag in the field of logistics. This is due to a number of reasons:

- sufficiently strong links are needed between manufacturers, suppliers and consumers, which must be combined into one system;

- the creation of logistics systems requires capital investments and sometimes quite significant ones;

- the pace of development of the production, technical and technological base of logistics in various sectors of the economy in recent years is very high and requires almost constant improvements or the introduction of new products, which requires significant one-time costs.

One of the basic priorities of the domestic and foreign policy of Belarus in modern conditions should be the accelerated integration of its trade and transport complexes into the global logistics space, the creation of favorable conditions for the free movement of goods, services, capital and labor.

Transport, serving almost all types of international economic relations, is the most important source of foreign exchange earnings in the Republic of Belarus, which acts on the international market as an exporter of transport services.

By the end of 2019, the share of the transport sector in the gross domestic product of the Republic of Belarus made up 5.9%. Transport services account for almost 42% of the country's total services exports and more than 50% of the balance of foreign trade in services. In 2019 the export of transport services generated more than $4 billion, with the trade surplus in this sector at $2.1 billion.

Around 11,300 organizations of various forms of ownership and 33,900 individual entrepreneurs operate in the transport sector of the Republic of Belarus.

In the Republic of Belarus, all types of transport are included in a single transport system, which has a very complex structure. All cargo transportation carried out in the country and abroad is classified according to the method of delivery (mode of transport):

• Trucking;
• Air transportation;
• Rail transportation;
• Sea and river (water) transportation;
• Pipeline transport [1].

The most important thing to consider when choosing a particular type of transport is information about the features of each type separately. In terms of logistics, each vehicle has its own advantages and disadvantages [3].

Road and rail networks are well-developed in Belarus. The road network in Belarus incorporates all types of road, including modern highways, which are the components of the Pan-European transport corridors. The country's public roads have a total length of 101,6 km, with more than 86 % of paved roads.

Belarusian Railway National Union is a railway network operator in Belarus, which handles 75 % of the total freight traffic and more than 50 % of the total passenger traffic.

Belarusian air transport is composed of companies, which provide their freight and passenger air transportation services performed both inside and outside the country. All of them are state-owned companies, which are under the authority of the Aviation Department of the Ministry of Transportation and Communications of the Republic of Belarus.

The major pipelines, that are necessary for the transportation of Russia's energy resources to the European energy market, cross the territory of Belarus. The total length of the pipeline network is 11,657 km, almost two- thirds of which are gas pipelines. The Druzhba pipeline and the Yamal Europe gas pipeline run across the territory of Belarus.

Ten river ports and forwarding companies, offering inland and maritime transportation services, operate in the river transportation system of Belarus [2].

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In 2020, the transport industry in Belarus faced a major challenge associated with the covid-19 pandemic. The decrease in the volume of transported goods and cargo turnover affected all types of transport. Rail and air travel were exposed significantly by the covid-19 pandemic.

There is a relationship between the level of economic development (as measured in terms of GDP per capita), the composition of a national economy, and logistics costs. But despite a high GDP per capita, Australia has a higher share of logistics costs than comparable countries because of the importance of mining in the economy, for example.

Anyway, the transport logistics of the Republic of Belarus is constantly moving forward and has very serious development prospects. All the problems faced by government agencies can be solved. All measures taken to eliminate the shortcomings are associated with the improvement of the legislative framework at various levels of government and close interaction of a large number of sectoral departments, the business community, educational, law enforcement, regulatory and other structures.

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Kryvaltsevich V., Yurchanka V., Ladutska N.

Warehouse Logistics

Belarusian National Technical University
Minsk, Belarus

Warehouse logistics includes the management of storage locations for the company's inventory. It takes into account all the diverse and complex factors – organization, movement and management. To understand how efficiently a warehouse management system can speed up a transport and logistics business, below are the main functions that a warehouse management system performs.

One of the primary functions of warehouse management systems is the effective tracking of the stocks that are coming in the warehouse and later dispatched to their various locations of order. The utilization of minimum and maximum levels of stock present and required severally in the market helps the business in managing their stocks and ordering them in the right quantity at the right time.

The second main function of a warehouse management system is to look after picking and shipping activities of a warehouse. It means, that the assurance of the correct product being received and shipping is taken care of by the WMS alone. With the help of the management system, it is possible to better track and manage all in the record book.

It is very fundamental to keep the warehouse's layout design much in order. A warehouse management system helps to draw the warehouse's layout design in its correct way. It enables placing products within the designed layout in a much more efficient manner with a logical setting working in its algorithm. This not only allows smooth operations but also

looks after a seamless way of managing products being correctly placed in the warehouse.

Since a warehouse is being controlled, managed and supervised by a changeable number of persons, staff management becomes very crucial. Having the benefit of real-time data about each employee's efficiency and performance is imperative for looking after the operations being right processed in the warehouse [1].

The advantage of warehouse logistics is simple, i.e. increased revenue. When warehouse operations come right, inventory is properly accounted for, the right item is sent at the right time, stock is replenished when needed, fewer picking errors occur, and all the people, processes, and systems fall into place as they should, warehouse operates more efficiently.

The required processing of materials in a warehouse involves such operations as:

Receiving goods – a warehouse accepts the merchandise delivered by a carrier or an attached factory and then accepts the responsibility for this merchandise.

Identifying goods – the appropriate stock – keeping units are identified and a record made of the number of each item received.

Sorting goods - the incoming goods are sorted out for the appropriate storage area in the warehouse.

Dispatching goods to storage – the goods are kept aside where they can be found later when needed.

Holding goods – the goods are kept in storage under proper protection until needed in the warehouse [2].

In order to improve the warehouse shipping process there are some recommendations below:

1. Label and track to increase transparency. GS1 has provided the business standards for machine-readable labeling since the first barcodes were introduced in the 1970s. These same barcodes make it possible to record product movement

through the supply chain, and Radio Frequency Identification (RFID) tracking can also be used to record GS1 standard identifiers without the laborious manual scanning of barcodes. So, products can be easily found within the warehouse even if they've been moved out of their normal locations.

2. Understand the total cost of business. Together with a supply chain management software system, machine-readable tracking makes collecting and comparing supply chain data easy. This allows business to determine if there are areas within the warehouse that are performing below expectations and creating bottlenecks in intake or order fulfillment.

3. Organization to make better efficiency. One way to do this is by increasing the number of products that can be handled within the same facility by implementing deep lane storage. Installing the pallet racking needed for a deep lane storage system is a major disruption in the warehouse that will limit operations, yet in today's supply chain system, a serious reorganization may be the best way to substantially improve the speed and accuracy of order fulfillment.

Lean warehouse management is the process of developing warehouse operations in such a way as to bring resource consumption to a minimum without sacrificing productivity. The original "five S's" referred to five Japanese words – Seiri, Seiton, Seiso, Seiketsu, and Shitsuke – which have been translated into English as sort, streamline, shine, standardize, sustain.

Sort. The goal is to realize specifically which aspects of warehouse operations are holding the team back from reaching their full potential. Identifying these areas is the first step toward working to optimize them – or to get rid of them completely.

Streamline. There are a number of possible ways to optimization of warehouse processes, such as: maximizing the accessibility of most-used inventory and fundamental

resources, improving warehouse navigability with an intuitive layout, accompanied by proper signage.

Shine. Make sure the warehouse is kept as clean as possible. This means: building cleanup processes into your overall warehouse workflow, ensuring cleaning materials are easily and quickly accessible, placing trash receptacles of appropriate size throughout warehouses.

Standardize. Some key ways to create this include: providing structured training to all warehouse staff members; creating individualized workflow documentation for each part of the warehouse team.

Sustain. Sustaining productivity demands equal parts adherence to existing protocols and continuous improvements over time. Sustaining approach to lean management involves: conducting formal and informal assessments with individuals as well as teams; soliciting feedback from team members on a regular basis; incentivizing adherence to protocols as well as providing feedback [3].

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Filatov A., Kazyro I., Lapko O.

The Impact of Game Engines on the Development of the Film Industry

Belarusian National Technical University
Minsk, Belarus

Every few decades, a technical revolution takes place in the cinema, renewing the industry. The appearance of color and sound, computer graphics, green screen, motion capture technology, new approaches to 3D in Avatar, all these innovations have completely changed the approach to shooting large studio projects. What will be the next revolutionary technology is still unknown, but one of the probable options is the use of game engines. First of all, we are talking about the Unreal Engine 4, which was used in the Marvel blockbusters, the new Star Wars and the Mandalorian series. Unreal Engine [1] was developed by EPIC games in 1998 to create 1st-person's shooters. In the following versions, the engine was simplified and became more universal, so now it was possible to create projects of any genre for all popular platforms. Unreal Engine 4 allows you to create games without long code writing, the local Blueprint visual programming system is available even to beginners. No special skills are required, you can create a new game based on Blueprint. Unreal Engine 4 has greatly influenced the gaming industry, because it was used to create Fortnite, Hellblade senua's sacrifice, Gears 5 and hundreds of other popular games, but it is also useful out of the gaming industry. For example, in interior design or even in filmmaking. Unreal Engine is distinguished from its competitors by photorealistic graphics and a huge library of assets. The fact is that the engine allows you to create a

elaborated and detailed world background, which is almost indistinguishable from the present. At the same time, there is another important advantage – it is a fast production process. Therefore, it is not surprising that the engine was quickly adopted by film studios. It is useful both in pre-production and creating special effects in real time. Now directors are increasingly refusing from the green screen and other popular technologies in favor of the Unreal Engine. An important feature of Unreal Engine 4 is a tool called "Sequencer". It solves problems in real time, moves fragments of the scene, selects suitable lenses, adjusts the lighting and sets the focus. Thanks to "Sequencer", the most popular way to use Unreal Engine 4 on the set was to create a realistic background. The technology can be used as a chromakey, but in real time. So now it doesn't take a few hours, but just a couple of minutes and just a few clicks. The Unreal Engine 4 pattern called “nDisplay” helps you create the backgrounds. It allows you to project an image on multiple screens or surfaces at once. The generated backgrounds are broadcast on huge LED screens and create the illusion that the actor is inside this space. Another useful tool for cinema is the “Stagecraft" technology, which creates and changes a realistic surroundings right on the set. Unreal Engine 4 also helps filmmakers with pre-visualization. Here, the role is played not only by the classic opportunities of the engine, which allows you to replace the storyboards with realistic animation, but also by special patterns for VR projects. Wearing glasses, the actor can interact with the environment in real time, helping to plan his movements in the frame accurately. While Unreal Engine 4 is still in the movies, it's still rare. The explorer here was the Disney Company once again, which has always been one of the first to use new technologies from rotoscoping to 3D animation. The main follower of using Unreal Engine 4 in movies is the director of Iron Man, the Jungle Book and the Lion King, as well as the

showrunner of the Mandalorian-Jon Favreau. He is who currently has the biggest experience in implementing game engines in the shooting process. It all started with the movie The Jungle Book, where the director was constantly put out by the necessity to change and move the chromakeys, and then Favreau decided to take advantage of the opportunities of Unity, another game engine. The engine was not used very often, it was used to create a pre-visualization of some scenes, which was broadcasted in VR glasses by the actor and the film crew. As the director put it, they created something like a multiplayer VR game about shooting a movie. It was the technology that became the basis for his next photorealistic remake of the Lion King, where virtual reality was already used in full. In fact, the film was originally completely staged by VR so that during the actual shooting, the crew could not start from storyboards, but from animation with ready-made light, color correction, operator techniques, and so on. The experience greatly influenced Favreau, because he was finally convinced of the effectiveness of his innovative approach.

In the series Mandalorian Unreal Engine 4 was already used, with the maximum [2]. Firstly, Favreau used the same strategy with pre-visualization as in the Lion King, and secondly, the chromakey was completely replaced with the LED screens with background projections created in the Unreal Engine 4. At the same time, the Unreal Engine technology helped with rendering not only exotic landscapes, but also fragments of the ship, which greatly saved on props. With the help of this in real time mode, the locations were modified, the time of day was changed and details were added that were immediately projected on the screens. Also, the engine from Epic Games is used to create animation, and as the main tool. In Unreal Engine 4, an entire scene of the cartoon In Search of Dory was drawn, and Pixar continues to cooperate with Epic Games. A full-length animated film based on Unreal Engine 4

is also not far off. Epic is working on a project called Troll, which is created using ray tracing technology, and starring actress Alicia Vikander. Jon Favreau and other directors who have used the technology agree that Unreal Engine 4 will significantly influence the future of cinema. The engine becomes easier to render, which allows you to achieve high-quality effects without unnecessary costs. At the moment, Unreal Engine 4 is far from the point where everyone can use it to create their own movie, but it already helps professionals to draw the necessary objects and backgrounds right in the production process.

The most obvious consequence of using Unreal Engine 4 is the death of the green screen. Like many revolutionary technologies from the last century, it will naturally be replaced by a new one, more convenient and cheaper to produce. Surely the shooting process will also change. In the Disney blockbusters, the visual production stage is already being introduced, and the storyboards are being replaced by the animation generated in Unreal Engine 4. If you try to look into the future, it is possible that thanks to this engine or a similar tool, cinema will become literally interactive. Watching how this technology is used today, you can only imagine how the viewer from the future changes the background and details of the film right while watching.

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Kusakova S., Lapko O.

The Impact of Video Games on Society

Belarusian National Technical University
Minsk, Belarus

The term virtual reality today is a key object of research in various fields of knowledge, and at the same time it enters all spheres of life of a modern person through computer technology. Today, virtual reality technologies can almost completely replace the perception of reality.

Reality is all your experience and knowledge of the world. Virtual reality is a virtual world created with the help of hardware and software, transmitted to a person through touch, hearing, and also sight. It is the combination of all these influences on human feelings in the sum that is called the interactive world.

Virtual worlds are the reality, the key to which computer games are played by children and adults.

The game is a sphere of emotionally rich communication that unites people with different social status and professional experience [1].

Computer games are now gaining more and more popularity, almost all of them can be found on the Internet. Many people play computer games in order to escape from boring reality. Video games are constantly becoming more realistic and challenging. New styles and genres are appearing [2].

For immersion in the game world, for example, to feel fear and horror, the effect of presence was created. The effect of presence is when it seems to you that you have physically

moved somewhere. The main contribution to creating the effect of presence is provided by computer graphics.

The game world is an artificial universe, an imaginary place in which the events of the game take place. Most video games represent their game world with images and sound: images, animations, music, and audio effects. The game world can have culture, aesthetics, a set of moral values, and other aspects [3].

Most people play video games on a daily basis. This is a common pastime to pass the time, or to get special emotions. Since the games are incredibly various and anyone, if they wish, can find something to their liking. Games develop the speed of thinking, reaction and other things that are widely used in the gameplay. We must not forget about the existence of educational games. These are games that were originally created with the aim not so much to give pleasant sensations as to teach the player something new. However, despite the listed advantages, in society at the moment it is widely believed that games have a harmful effect on a person. Addiction, imbalance, and sometimes even suicide are all attributed to the influence of games. This is not to say that all this is an absolute lie, since such cases are actually registered. People are really easily influenced by games. And this is more dangerous for children. Most children are not able to control this temptation, as they live in the present day. They don't think about education and the future, they think that they can get a range of emotions right now with the help of games, and sometimes this desire absorbs them entirely. The responsibility of parents isn't to completely cut off access to games, but to control the condition of the child. After all, with proper control, one day the child will play enough, grow up and will already be able to estimate the necessary time for games on his own. But he may not completely stop playing games. But they will no longer pose any threat. Games will turn into a hobby. On the other

hand, a child who has been banned from playing all his life once in an older age can throw off the fetters of tight control and dive headlong into this world. At a time when his peers can already control their thirst for games, he will spend all his time avidly in them, that time that already needs to be spent on education and his future. Because of their strong influence, video games partly shape a person's personality type. And this type is strictly dependent on many factors. A person can completely lose communication skills, or develop them through communication with other players. He can be hot-tempered, but able to make quick decisions, like players of shooters, or be judicious and attentive, like players of various strategies. And there are many examples. So the conclusion is that video games need to be controlled, but not banned. For under the necessary conditions, they can bring up the extremely strong sides of a person.

The practical significance of computer games has a significant impact on the attitude, worldview of a modern person, they become not only objects of cultural leisure, but also a new professional activity.

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Belyi E., Lapko O.

Popular Sorting Algorithms

Belarusian National Technical University
Minsk, Belarus

What is a sorting algorithm and why do we need it? In computer science, it is very common to sort the input data. Therefore, it is very important to find the most optimal way of sorting, which is the main concern. There are a lot of sorting algorithms known to men now, but the article deals with the most famous and popular ones.

Quick sort. Qsort was invented in 1960 by Tony Hoare. The algorithm was developed according to the Divide and Conquer method according to the principle of direct movement. It works thanks to recursion. The function receives an array. Then the function selects some pivot element, and then splits the array into two arrays. The first array contains elements which are less than the pivot one, and the right one contains larger elements. Then the function calls itself and gives these two arrays as input. Best case is O (n), average O (n logn) worst O (n ^ 2). The disadvantage is that the algorithm does not have stable variants, an outdated method has been used, to which a better alternative has long been found. There advantages of this algorithm worth mentioning. First of all it's easy to write, it uses a small amount of memory. Moreover, it works faster than its counterparts.

Tree Sort. This sort of sort uses the principles of a binary tree. A binary tree is a kind of dynamic structure consisting of roots, nodes and leaves. The topmost element is the middle element in such a structure. Two nodes extend from it, and more nodes extend from the nodes, and so on to the extreme

lower elements - leaves. Typically, the left branch is smaller than the root, and the right branch is larger. The principle of this sorting is that we are trying to build a binary tree from the array given to us. And then we perform a depth-first traversal with the formation of a new, already sorted array. Best case is O (n logn), average O (n logn) worst O (n ^ 2). The biggest disadvantage of this sort is the tree's imbalance. When the root element is incorrectly defined, some of the branches of the tree grows longer, which leads to degradation of the sorting and reduces the time to O (n ^ 2) time complexity. Therefore, numerous modifications have been written for this sort to allow rebalancing of the tree. Thanks to this modification, the algorithm becomes one of the few stable sorts, and the time complexity is reduced to: the best case is O (n logn), the average is O (n logn), the worst is O (n ^ 2) Its disadvantage is its complicated implementation. The advantage of this algorithm is its stability. It also should be mentioned that it is one of the fastest algorithms.

Radix sort. Bitwise sorting is applied in as many steps as there are bits in the largest element. There are many types of this algorithm, but the most functional of them is LSD (least significant digits). It works exactly as its name suggests. First, it sorts the numbers by units, then sorts by tens, keeping the results of the previous sorting and so on until the last digit. There is also a type MSD (most significant digits), working towards the lower digits. A stable sort that has a time complexity of O (w * n), where w is the number of bits that need to be spent to store the maximum number. Its disadvantage is high time complexity. The advantages are the ease of writing and stability.

Bucket Sort. Pocket (Block) sort uses the same method of operation as qsort. For a successful sort, we must make sure that the array data obeys a uniform distribution law. If so, then the algorithm has one of the fastest time complexity. Like

many algorithms, this sorting works in two stages. The first stage - the algorithm creates an array of arrays into which it writes ranges of numbers (baskets). It then walks through the array and writes the values to the bucket data. Since in the preliminary stage we confirmed that the array obeys uniform distribution law, then we expect that there will be few values in each basket. After that the second and final stage comes - sorting takes place inside all the baskets and the generation of the final array. The disadvantages are the complexity of writing this algorithm and the instability of its work. The advantage is the linear time complexity of the O (n) algorithm.

And finally, let's move on to the most advanced sorting at the time of this article - TimSort. It was invented in 2002 by Tim Peterson. It is a hybrid algorithm consisting of insertion sort cooperation and modernized merge sort. This sort is one of the few quicksort algorithms with stable results. One of these sorts is the binary tree sort, which has already been described above. The main idea of this algorithm is that the array given to us may already have some sorted parts. TimSort finds or recreates these parts at the stage of reading the array. The algorithm itself works in three stages. The first stage - after entering the data, we perform a partial sorting and split the array into several practically sorted arrays. The second step is to perform a secondary insertion sort, which works fine for this data type. And the final step is to generate a new array of their sorted arrays using merge sort. This is how the currently best sorting algorithm works, which has already been recognized and used in the standard Java, Python and Kotlin libraries. Since this is a fairly new algorithm, serious flaws have not been identified yet. The advantages of this algorithm include relative ease of writing, stable operation of the algorithm with time complexity O (n logn) [1].

Count sort. Count sort is a linear sort that uses memory. It works only with whole data sets of small diversity. The

principle of the algorithm is that it creates an array from the minimum element to the maximum. If the index of an array element coincides with the value of the array, then the value of the array element with this index is increased by one. Therefore, this algorithm has a linear tricky execution. In the worst cases, the program just doesn't work.

Shell Sort. It was invented in 1959 by Donald Schell. The algorithm works on the principle of enumeration by the direct displacement method. It works cyclically. In each cycle, a certain number is selected, in what follows we will call it a step. Next, we go through the array and change the elements to the left and right of the pointer on the left and right sides. Thus, the algorithm can swap several elements. Its disadvantages are old method of work and low productivity. But at the same time it is more stable than qsort and easier to write.

Bubble sort. Probably all of you have heard of bubble sort, the most primitive sorting of the existing ones. We go through the array as many times as there are elements in it, decreasing it each time. Thus, its time complexity is O (n^2). Its disadvantages are low performance, outdated method, primitiveness. Its advantage is that it is easy to write.

Thus, in this article, the key sorting algorithms, their advantages and disadvantages, the principle of their operation, the methods and ideas laid down by the developers, the time complexity were analyzed.

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Veremeychik A.V., Lapko O. A.

Markup Languages

Belarusian National Technical University
Minsk, Belarus

We all use the Internet every day, looking for the information we need. We do this for different purposes: work, entertainment, education, etc. And in the end we find the information on different websites. But have you ever wondered how this information is displayed on page? Have you not? Then in this article I will try to explain how it is possible.

Any information (text, pictures, videos, etc.) on websites is displayed using a special kind of computer languages - markup languages.

First, let's figure out what a markup language is. In simple terms, it is a set of symbols, instructions (tags) that allows you to structure the text on a website and determine how various elements of the structure interact with each other. In other words, a markup language helps to determine where a title, subtitle, body, author words, etc. should be. There are many markup languages. The most famous of them are HTML, XML, XHTML and CSS [1].

Many people call markup languages programming languages because they think they are the same thing. But this is not the case. Markup languages are a collection of tags that helps the browser to understand how text is placed on a website. With their help we specify different parameters, for example indents, font, text size, color, etc. Programming languages allow a programmer to communicate with a computer in a way. With the help of built-in programming languages functions the programmer gives the central

processor commands that it must perform (mathematical or logical operations).

In modern times markup languages have become very advanced. They allow website developers to do whatever they want with the text, customize it in great detail. But where did it all start? We'll find out now.

Initially, the concept of hypertext was mentioned in 1945 in the article “As We May Think” by Dr. Vannevar Bush. In that article he put forward a concept for a machine called "Memex". It was a knowledge base designed to store various types of scientific materials. Bush wanted to assign a specific index to all of the cells of this vault. With such index the cells would be accessed with a few keystrokes. It was also assumed that it was possible to add your own scientific materials. But this machine was never invented [2].

The first functioning hypertext application was the HES (Hypertext Editing System). It was developed by Ted Nelson and Andries van Dam in 1967 in collaboration with students at Brown University. This system worked for the IBM / 360 mainframe. The development team was funded by IBM. The essence of this system was that it converted a large amount of information into branched text and links. The "back" button was used for the first time in HES. As a result, the system was sold to NASA and was later used in the preparation of documentation for the Apollo project.

A year after finishing work on HES, Andries van Dam created FRESS (File Retrieval and Editing System). It was the first commercial hypertext system. The innovation was that with the help of FRESS several people could work on a set of documents at the same time. It was also the first system to have an «undo» function that allows you to go back one step [3].

But despite all previously mentioned discoveries, IBM employee Charles Goldfarb is considered to be the real «father» of markup languages. In 1969 he worked on a system

for law firms that was designed for routine document management. While working on this project he came up with an idea of creating a complete markup language. In the same year Goldfarb led the development of this language. 4 years later in 1973 a language called GML (Generalized Markup Language) was first introduced. It did not depend on computer model or operating system. The text could be easily edited or adjusted to another device as the text was tagged. With those tags' help it was easy to determine where the title, subtitle, author's words, etc. were.

In 1974 Charles Goldfarb continued the development of markup languages. This led to creation of SGML (Standard Generalized Markup Language). In 1986 ISO organization awarded the language with a status of an international standard. This language defines the allowed set of tags, a general structure of the document. It has been widely used in printing and publishing. But due to its complexity SGML is commonly used to create custom tags or even other markup languages.

In 1993 the first version of HTML (Hyper Text Markup Language) markup language was released (version HTML 1.2). It was based on SGML. It was developed by Briton Timothy John Berners-Lee. The main goal of creating this language was to simplify the use of SGML. Berners-Lee wanted to make a markup language that any developer could quickly learn to work with. HTML is still widely used today. Its latest version (HTML 5.3) was released on December 24, 2018. Many developers use this language to design sites.

Since 1996 the development of the eXtensible Markup Language (XML) has been underway. Development was led by the W3C (World Wide Web Consortium). It was based on SGML. XML is a meta markup language. The main purpose of its creation is for it to be simpler than SGML. At the same time this language was designed to have its focus on working on documents on the Internet. This language allows you to

describe user interface for mobile devices. XML is very useful for storing and transmitting data over the network. It is possible due to the fact that an xml file is easily readable by both humans and computers. Therefore, there will be no compatibility issues when transferring the file to another computer.

After 4 years, the W3C organization launched the development of the XHTML (eXtensible Hypertext Markup Language) markup language, which combined two languages in one: XML and HTML. It was created due to the fact that after the release of XML users needed elements of both of the two languages [4].

I hope I was able to tell you about markup languages and their development history in simple words. I want to say that the development of markup languages is not over. It continues to grow actively along with the technology development. I can't even begin to imagine what awaits us in a few decades.

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Koroliov P., Lapko O.

Virtual Reality

Belarusian National Technical University
Minsk, Belarus

The article discusses a completely new sphere of modern technologies. The goal of the article is to define the concept of "virtual" and reveal the original term "virtual reality." From the article one can find out how a person uses virtual reality in various areas of activity, as well as how VR was developed, what potential it has in the future.

The nature of human society is constantly gaining new fields of knowledge. Virtual reality is a space created artificially, using technical means. VR replicates the world around it, gives a sense of presence and immersion in another dimension. Special effects are perceived by human consciousness, give a sense of reality of presence. You can touch, hear and see, even feel what is happening on the screen. The essence of visual modeling is the application of human behavior, their attitude to the surrounding objects of reality, and interaction with them.

Virtual reality (VR) is an artificial world that does not exist in nature, into which a person can completely "immerse" not only as an observer, but also as a participant.

The virtual reality system should give the user response to the actions taken a picture, sound, as well as a complex of tactile and other sensations instantly, without noticeable delays.

It supports one or more users. Virtual reality systems are distinguished by the number of simultaneous users and divided into individual and collective. As a rule, individual systems are

created on the basis of display devices, with which only one person can work (helmets, glasses, etc.).

The VR system should produce a stereoscopic image that provides a sense of the depth of space. A person has binocular vision, that is, he perceives the world with both eyes at once. At the same time, the images observed by each eye are slightly different from each other and individually do not have bulk, but our brain adds two pictures into a single three-dimensional image. Modern technologies for generating pseudo-volumetric pictures are based on this effect, and so-called stereoscopic pairs of images have been created that provide the illusion of volume.

Interactivity is the ability to interact with the virtual world. In a "virtual universe," the user must be an exclusively active observer. It should be able to interact with the virtual environment, and it will in turn rely on user actions. This allows the user to look around and move in any direction within the virtual environment.

The first use of the concept "virtual" was found in the 15th century literature. It was meant "something that was not really there [1]." In the early 60s of the 20th century, virtual meant something created thanks to a computer program. In 1982, Damien Broderick used the term "virtual reality" in his Judas Mandala novel in the science fiction genre.

The early instrumentation of virtual reality occurred in 1962. Then Morton Heilig showed the first prefiguration of a multi-sensory simulator called Sensorama. Viewers immersed themselves in virtual reality thanks to the short issues of Sensorama. It was possible to feel the smell, wind and sounds of the big city.

In 1967, Ivan Sutherland designed and made a description of the first helmet for a computer. Any user could understand its interface and visual implementation, but the HMD (head display) was too heavy to put on his head, so it

was attached to the plafond. Virtual graphics included primitive model rooms with wireframes. The device had the specific title – the "Damocles Sword." The helmet allowed you to change images using head movement.

In the 1970s computer-generated imaginary completely replaced video. Previously, it was used in different types of simulators. At the same time, the imaginary was the easiest one, but flight simulators could work in the real time environment. In the early 80s the Institute of Technology in Massachusetts produced the first virtual reality program, which was called "Aspen Movie Map." It was a simulated walk through the city of Aspen in Colorado. Various methods of displaying the terrain were offered for choice. To display two seasons versions, real photographs of the city were used.

Until the 90s the "virtual reality" industry was improved and widely distributed among users, and research on VR technologies continued. After 1990, the first series of this product began to appear in computer stores. So, in 1994, Sega introduced a simulator of the Sega VR-1 movement for Sega Machines World. This simulator reacted to head movements and was distinguished by 3D graphics. It was produced on the basis of the Sega Model 1 motherboard. In 1995, the Nintendo Virtual Boy console was released [2].

Application. VR is necessary for professional training for train drivers, aircraft pilots, climbers and rescuers, etc.

In recent years, virtual mechanisms have proved to be a powerful tool for learning. So, with the help of VR, you can perform certain tasks.

Case Western Reserve University approved the introduction of augmented reality technology Microsoft in student education. With the help of VR, San Diego teacher Charles Kumber was able to explain the topic "Types of angles in geometry" in just 17 minutes.

Virtual reality capabilities are also widely used in industry and construction. This technology is considered to be an element of the fourth industrial revolution. In the field of construction, VR is used in two areas - designing and finding optimal solutions by architects, designers and engineers. So, the customer can view the visualization of the future project both completed and during the work stages.

Virtual reality technologies are being actively introduced in various fields of human activity. These are engineering, design, mining, construction, etc. The coronavirus pandemic that happened in 2020 set a sharp pace for the development of VR.

So virtual reality today is not just entertainment or a computer game. It allows you to model, train, conduct tests and do work on errors in complex professions. The further development of technologies will make most of the capabilities of virtual reality, which will benefit human activity in various areas.

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Fedosova V., Levitskaya M.

Education in Third World Countries

Belarusian National Technical University
Minsk, Belarus

All children have a right to free and quality education. The right to education for everybody is the central goal of our millennium. Unfortunately, it is unattainable for many poor countries.

In some countries, children receive primary education, but it is not enough for their subsequent development. This is because teachers are poorly trained and paid, classrooms are overcrowded, and there is lack of basic learning materials such as textbooks, blackboards, pens and paper. The problem for many developing countries is that governments lack financial and political resources.

If we lived in an ideal world, primary education would be available to everybody and funded by the government, and all children would be able to go to school. When a child does not acquire the basic education necessary to become an educated and responsible member of society, the whole society loses out. Sadly, according to the United Nations Development Programme, some 113 million children worldwide were not in school at the end of 2003.

Since education is a universally recognized right for everyone, it should be paid for by the state. In poor countries, however, governments are unable to fund education.

Children in developing countries (the African and Asian regions) and in countries with difficult economies are excluded from education. It is worth noting, though, that much progress has been made since the Millennium Development Goals (the

UN programme to achieve the global Millennium Development Goals) came into force. Many developing countries have already completed the process of achieving universal primary education. Such countries include Chile, China, Cuba and Sri Lanka. Others should follow suit.

Some states have the potential to develop education but resources may simply not reach schools because of corruption or inefficiency. Publicly funded schools may be available in urban areas but not in rural areas, or may vary widely in quality. In addition, public resources may be diverted from education to other programmes, such as military construction, which are endorsed by the upper classes seeking to protect their interests. Corruption is another reason why children in poor countries may not have access to quality public schools: public officials may avoid spending on schools in favour of expensive projects such as the defence sector or road construction, since funding for these projects can be more easily misappropriated. The ideal and correct goal of education policy remains universal education financed by public revenues.

What can be done at the moment? First, even minimal payments can cover teachers' salaries, learning materials, pencils and textbooks and school repairs. Or parents can pay with in-kind items, such as bringing food to teachers, helping to run classes, or making school repairs themselves.

There are several main reasons why access to education is difficult.

Children in many countries find it difficult to attend school because of the location and climate of their country. For example, in some high mountain areas (e. g. India), adverse weather conditions can last for months, causing children to stay home and miss school. In many rural areas, students simply cannot get to school. The geographic location of an area greatly affects access to primary education.

Another reason is the gender inequality that still exists in the third world countries. The days when girls were not allowed to be educated at all are over, but the gender bias still remains. Countries like Nepal, Yemen, India and Togo are among them.

Language of instruction is another cause of discord. Schools do not teach in the mother tongue but in the national language. At home children still speak their mother tongue. It is difficult to learn.

We shouldn't forget the financial issue either. The cost of schooling and the inability of many families in developing countries to provide schooling for their children is also an important reason. Parents in rural areas prefer to send their children to work in the fields or stay home.

Demand for education also depends on perception of its value. But money is not always the main issue. For example, the Progress programme in Mexico has cut school fees by more than half, but enrolment has only increased by 10 per cent. Under this programme, the government pays district heads directly, who distribute funds to women on condition that they send their children to school and take them to hospitals for check-ups. It is in countries like this, where low demand for education is not related to cost, that school attendance will not improve unless cultural barriers and prejudices are overcome.

Parents may not have enough information to correctly assess the return on investment in their children's education, or they may believe, sometimes justifiably, that the return is too low to justify the cost - perhaps because of the poor quality of education available to them.

Education is one of the most important parts of our world and it must necessarily be available in every corner of the planet.

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Sakharova K., Levitskaya M.

Risk Management System for Customs Control of Transported Goods

Belarusian National Technical University
Minsk, Belarus

When conducting customs control, the customs authorities of the Republic of Belarus proceed from the principle of selectivity and are limited only to those forms of customs control that are sufficient to ensure compliance with customs legislation, i.e., when conducting customs control, a system of risk analysis and management is used (hereinafter referred to as the SUR). In conditions of constant growth of the number of controlled persons and expansion of the nomenclature of the transported goods, this system allows to optimally allocate the time and labor resources of the customs authorities in the most important and priority areas of work, thereby contributing to the rhythmic passage of individuals, goods and vehicles across the customs border.

In order to effectively apply and further develop this system, the State Customs Committee of the Republic of Belarus has formed a legal and methodological framework for the SUR, created an appropriate organizational structure, and implemented the necessary software.

The main goal of the risk management system is to create a modern customs administration system that is able to ensure the effective operation of customs control, based on the principle based on the optimal allocation of customs service resources in key areas of the customs authorities' work in order to minimize violations of the customs legislation of the Russian Federation. Goal Data:

- they have a permanent character;

- they are based on the evasion of customs duties and taxes on a serious scale;

- they have a negative impact on the competitiveness of domestic producers;

- they relate to important issues and interests of the state, the observance of which is in the department of customs authorities.

The experience of applying the risk management system can be evaluated in other countries, and since it shows a positive result, it becomes clear that its application is very effective in the work of customs authorities.

Procedures based on risk management make it possible to control the production of customs clearance in the areas with the greatest risk, allowing most of the goods and individuals to pass through customs control relatively freely. Kyoto Convention (1999), General Annex, Chapter 6, Guidelines on Customs Controls, p. 36 [1].

The risk management system is one of the main components in the activities of customs control, according to the standards proposed by the World Trade Organization (WTO), they are as follows:

- minimizing the time of customs operations;

- full transparency of customs procedures in relation to all participants of foreign economic activity;

- partnership relations between customs authorities and participants in foreign economic activity.

There are two types of risks: identified and potential. The identified risk is a known fact of violation of the legislation of the Republic of Belarus, which has already occurred and the customs authorities have information about this fact. Potential risk is a risk that has not proven itself, but there are all the conditions for its occurrence.

Risk goods – goods that are moved across the customs border and have been identified or identified as potential risks.

Cover goods are goods that can be claimed as substitutes for risk goods. The objects of the analysis are the following categories: Goods that are under customs control or released for free circulation in the customs territory.

Vehicles that are commonly used in international transportation for paid transportation or for free industrial or commercial cargo transportation.

Information contained in transport, commercial or customs documents. Information contained in contracts of international sale and purchase or in other contracts concluded during the execution of a foreign economic transaction, and in the case of a unilateral foreign economic transaction-documents describing the content of this transaction.

Activities of persons acting in a capacity sufficient in accordance with the Civil or Customs Code of the Republic of Belarus to perform on their own behalf legally significant actions with goods under customs control.

Activities of customs representatives, owners of temporary storage warehouses and customs warehouses, as well as customs carriers [3].

management system is designed to perform a number of functions, for which it was invented and developed. They are as follows:

- creating a unified information system that allows the risk management system to work normally;
- development of new methods for determining risks;
- identification of potential risks and registration of already identified risks;
- determination of the reasons and conditions that may have an impact on the commission of customs offenses;
- assessment of the expected damage in the event of potential risks and damage in the event of detected risks;

- establishing the possibility of preventing or minimizing risks, including determining the resources that are necessary for this and their optimal allocation;

- production in relation to the search for new ways and methods of evaluating the effectiveness of the measures applied;

- development and application of measures to prevent or minimize risks;

- monitoring the implementation of measures to prevent or minimize risks in practice;

- assessment of the level of effectiveness of the applied risk management measures and adjustment of management decisions;

- creating a database of information by analyzing the results of the application of individual forms of customs control or their totality, including the causes and conditions that may provoke a customs offense, in order to develop proposals for the modernization of the customs control strategy.

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Sotvaldieva A., Muhina K., Levitskaya M.

Green Logistic

Belarusian National Technical University
Minsk, Belarus

In the early 90s, the concept of "green" logistics appeared in the foreign scientific literature, which became one of the components of the concept of sustainable development. The term «green logistics» is also synonymous to "environmental logistics" or «ecologistics». Despite the fact that the concept itself appeared more than twenty-five years ago, there is no single definition of this concept. The term and various approaches to understanding the environmental component of logistics are common.

Particular attention in the practice of business structures is paid to correct behavior in relation to the environment, including logistics functions the implementation of which should be carried out with the use of resource-saving technologies and environmental assessment of the impact of resource processing on the environment. This is also due to the fact that logistics is responsible for the movement of material flows along the supply chain through the operations of transportation, warehousing, consolidation of goods and, thus, has close contacts with the environment

The main characteristic of our time is rapid development, but recently we have begun to realize the destructive power of our actions: the consumer attitude has led to a number of serious problems that must be solved at the international level. In this regard, ecology has become not just a buzzword, its influence extends to many areas of our life.

Since the transport industry has been recognized as one of the main sources of environmental problems, it has led to the emergence of the first legislative acts, which consider such aspects as emission of pollutants, noise control and efficient use of resources. Coverage of these issues showed, that the development of green logistics strategies provides an opportunity for the transport industry to become more environmentally friendly.

Green logistics is a supply chain management strategy that aims to reduce the negative impact on the environment. Considerable attention is paid to the processes such as eco-friendly packaging, transportation, and waste management. In a broader sense, the concept implies several aspects: production planning, management and distribution of material flows.

The main objectives of sustainable logistics include: measure the carbon footprint of logistics operations, this is due to the fact that transport industry provokes the emergence of the greenhouse effect; reduction of soil, air, water pollution; lowering the noise level, rational use of resources, etc.

The fight against the detrimental influence on the planet is progressing slowly, but the logistics is making progress. For example, European countries are encouraging transport companies to use electric vehicles instead of diesel.

Raben (Dutch logistics company group) shows a good example of the introduction of green technologies. The company has developed a calculator that can be used to calculate the amount of carbon dioxide emissions from their operations. In 2019, the company also tested liquefied natural gas (LPG) in tractor vehicles. These vehicles emit much less CO2 and minimal particulate matter into the atmosphere.

Warehouse logistics is also involved in green technologies. In 2020, European developer Panattoni built a logistics distribution center for the German online store Real Digital. The warehouse is located in the Czech Republic, its

area is more than 27 thousand. The distribution center is considered the most environmentally friendly in the world. To build a new warehouse, the developers demolished an old building. More than 90% of the construction waste was recycled and used to build the distribution center.

The warehouse uses rainwater which is picked from the roof of the building for utility purposes. Due to this, the company was able to reduce its water use by 84%. Savings are also achieved through electricity - blinds are installed on the windows of the distribution center, which prevent the building from overheating, and the use of air conditioners is minimized. Smart LED light bulbs, energy optimization systems are installed throughout the distribution center. Thanks to these innovations, Real Digital has reduced its carbon footprint by 58%. Electricity costs decreased by 56%.

In our country, the ecologist has not yet found wide application either in the logistics sphere or in the production field. This is due to certain problems with the introduction of "green" technologies that manufacturers face: lack of interest from the manufacturer; lack of skills to use the principles of "green" logistics in the activity; lack of professionals in this field; uncertainty of the result; maintenance costs of environmental technologies and innovations.

Anyway, environmental logistics becomes more and more popular in the developed countries with new perspectives emerging regularly: construction of new logistics and multimodal centers to improve the efficiency of logistics enterprises and freight transport in the country as a whole; introduction of specialized technologies in warehousing for more efficient organization of space and, as a result, reduction of warehouse area and energy consumption; development of the transport system, transport interchanges, construction of new roads; reducing the share of road transportation, replacing it with sea and water transportation; informing consumers

about the environmental politics of the company by marking the packaging with special signs; development and promotion of waste recycling, reduction of tariffs for recycling (many entrepreneurs do not deliver waste to the recycling areas and leave it at the gates of recycling enterprises due to high rates of waste delivery).

The government needs to develop a number of measures to prompt companies to socially responsible activities through various benefits. That will definitely serve as motivation to switch to "green" supply chains, which will increase the supply of necessary equipment and personnel in the field of "green" logistics.

The world's leading companies consider the logistics concept based on "green" technologies to be the highest priority focusing on reducing the resources used, creating the most complete cycle of waste disposal and use, and reducing the anthropogenic burden on the environment. The transition of foreign companies to eco-friendly safe production improves significantly their reputation and social status.

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Belkevich A., Belousova M., Levitskaya M.

The 11th of February - International Day of Women in Science

Belarusian National Technical University
Minsk, Belarus

The history of The International Day of Women and Girls in Science started with a resolution about development of science and technologies on December 20, 2013. Equality of all genders from the point of view of innovations and discoveries was accepted in this document. And in 2015 it was proposed to announce an official holiday devoted to women-scientists and girl-scientists in honour of gender equality in the world of science.

The first celebration of the Day was held on February 11, 2016 and was marked by the forum at the UN headquarters. The annual celebration of this day aims at drawing additional attention to women's participation in the scientific field, and to highlight the achievements in the field of science, technology and innovation made by women and girls.

The main argument for establishment of the holiday was the fact, that it would promote the faster and better implementation of the plan for the development of humanity until 2030 for the transformation of our society [1].

The goal of the plan is fight gender inequality. Although the world community has made significant progress in this area over the past 15 years, women and girls still face barriers in this field. Today women make up less than 30% of researchers worldwide.

The resolution calls on all countries of the world to pay attention to the existing problem, to try to identify the causes of

the gender imbalance in the field of science, technology and innovation, as well as to organize programs of activities to involve women and girls in the scientific environment [2].

Girls are also mentioned in the name of the holiday with the aim to update the topic of participation in scientific communities, circles and other associations of the scientific profile of the school period of education not only for boys, but also for girls, whose participation in them is also noticeably lower. In addition, the participants of the events as part of celebration of the new International Day pay attention to the work of educators and teachers in school and preschool education institutions, where the principles of gender equality should be taken into account [1].

By 2021, only 23 women scientists who have made discoveries in physics, chemistry and medicine have won the most prestigious scientific award in the world, and more than 620 people have received the Nobel Prize in these fields of science.

UNESCO also recalls that especially few women work in the information and telecommunications sector: they make up only 3% of information and communication technology specialists and 5% in natural sciences and mathematics.

One of the reasons why women scientists are generally absent from the history of science is that it is not so easy to find information about them in the public domain. Even today, the number of women in science remains lower than the number of men, especially in some fields. Only12 % of candidates in the field of computer technology and 22 % in physics in 2018 were representatives of the weaker gender [3].

Another reason is that women do not fit the conventional image of a scientist. The idea of a male researcher is stable. But a look at history can both challenge this image and provide some explanation for why science still has such a masculine bias.

The traditional view of science as a body of knowledge, rather than an activity, ignores the contributions of women as co-authors, focusing instead on the facts gained from big discoveries and the men who made them public.

The historian Margaret Rossiter called this systematic bias against women the «Matilda effect». The Matilda effect is the systematic denial of women's contributions to science, the belittling of their work, and the attribution of women's work to male colleagues. The essence of it is either to completely deny their contribution to science, or to belittle the significance of their achievements, as well as to attribute the discoveries made by women to their male colleagues [4].

Currently, the exclusion of women from the field of professional activity is one of the reasons that they have become more active in those scientific disciplines that still rely heavily on field research, such as astronomy and botany. It was here that science began to divide into a hierarchy of "hard" male-dominated sciences, such as physics, and "soft" sciences, such as botany and biology which were considered more acceptable to women.

While we should be careful not to overestimate the historical activism and role of women in science, it is important to remember the scientists who have contributed greatly to science and the barriers they have overcome for science. This is one of the areas of work to overcome the continuing tension between femininity and science, as well as to provide women with role models and to increase their participation in all scientific disciplines [5].

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Ermakovich E., Levitskaya M.

Internet Access in Developing Countries: Africa

Belarusian National Technical University
Minsk, Belarus

The average person spends nearly six hours a day on the Internet. In contrast, over 4 billion people are without internet access. In most cases these people are concentrated in developing countries [1].

Almost all African countries now have their own Internet connection. In 1995 only seven countries were connected to the Internet (Zambia, Mozambique, South Africa, Egypt, Zimbabwe, Namibia, Tunisia). But only around 70000 people in 47 countries use the Internet, 15000 of them in Kenya.

Currently, the average cost of using the Internet for 5 hours a month in Africa is about $ 60 per month. These contrasts with the following fact: 20 hours of Internet in the USA costs $ 29, including phone and provider fees. There are huge differences between the costs of using the Internet. The cheapest access is in Botswana — $ 11 per month, and the most expensive in Angola — $ 145 per month [2].

In addition to the high costs, the poor telecommunication infrastructure prevents the Internet from becoming more widespread. Africa has the least developed infrastructure in the world: only 2% of the world's telephones.

«The lag in communications technology is not only because of financial or technical factors. The average cost of installing a telephone connection in Africa is still around four times higher than in the rest of the world» [2].

However, some African countries pay a lot of attention to expanding telecommunication infrastructure and installing

the latest technologies. For example, in Botswana and Rwanda, all main lines are digital. But most countries have outdated analog lines, which are extremely unreliable, especially during the rainy season.

However, for the World Wide Web (WWW), stable and fast connections are essential. Good international connections are also required for this. But the international bandwidths are also still very poor on the African continent.

A stable power supply is one of the basic requirements for connecting a computer and access to the Internet. However, around 70% of Africans in rural areas live without electricity.

In addition, politics in many countries hinders the growth of the Internet. Political restrictions are common in many countries.

One way to give more people access to the Internet is to set up Internet cafes and telecenters. Since May 1996 Peru has been pioneering the use of such "cabinas publicas", which were mainly set up in universities, schools, public buildings and in private companies [3].

In addition to the technical factors, the human factors also play a major role in the spread of the Internet. There are two terms for extensive Internet use: literacy; knowledge of English language.

The illiteracy rate in most sub-Saharan countries is over 50%. Only about 8% of all Africans speak English. In addition, there is a lack of computer skills. Attempts are made to overcome these barriers through new software developments.

The developing countries in sub-Saharan Africa do not have the finances to drive the expansion of the Internet. Companies such as AT&T, MCI, France Telecom and Deutsche Telekom are investing billions in the construction of the telephone network [3].

The Internet could bring the underdeveloped regions back into the world economy and narrow the gap between the

rich north and the poor south. The spread of networking in Africa can improve the quality of life of significant numbers of average Africans.

The main argument for the spread of the Internet is the connection to the global economy and the creation of new workplaces. In addition, there is the possibility of marketing agricultural products.

One way of creating workplaces in the third world is certainly the outsourcing of jobs, especially in the field of software development. If new workplaces are created in Africa, it can help with the following problem: the brain drain, which is so dangerous for Africa.

In addition to the unequal access to information, the unequal global information order is particularly criticized. The international structure of the flow of information is still based on information channels from the colonial era.

Internet access can enhance intra-regional collaboration among African organizations. Moreover, anyone with Internet access can put their own information online and thus participate directly in the dissemination of information.

The problem, however, is that the African states do not have the necessary financial resources to drive the expansion of the telecommunications infrastructure on their own. There is also the risk of cultural imperialism.

Can the Internet serve as a tool for education and science? In the scientific field, the Internet gives Africans access to information. The Internet can also bring enormous progress in the field of medical care. A good example of this is the databases of the World Health Organization (WHO) or the HealthNet, which is based on a different technology, the Fidonet which could also work via the Internet [3].

Healthnet helps clinics, medical schools, and ministries of health in many parts of Africa establish electronic mail communications. Access to Healthnet enables health care

workers to participate in discussions with prominent scientists and doctors in neighboring countries and around the world.

So we can conclude that it is guaranteed that everyone with access to the Internet can participate in the dissemination of information. The Internet can bring a modernization to Africa without an inevitable adjustment of cultures to Western values. On the other hand, African culture can also influence Western culture.

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Podobed O., Klopova V., Levitskaya M.

Social Networks: Harm or Benefit?

Belarusian National Technical University
Minsk, Belarus

The 21st century is the age of globalization and high technologies. So the main reason of choosing the topic is the relevance of this problem. Now the modern world is already difficult to imagine without the Internet and social networks. People spend a lot of time in virtual reality.

So the purpose of the work: to find out what impact social networks have on a person – positive or negative.

Talking about how the Internet was created, one can't but mention that the Internet is a dimensionless virtual space where you can find all that you want. The history of the Internet began in USA owing to Bob Taylor who worked in the Office of Advanced Research (ARPA) of the US Department of Defense in Washington. Its semblance of the Internet was created only for military purposes – communication between military objects in case of a nuclear war. It was named ARPANET. The network gradually developed, but was still inaccessible to the general public and was used only by scientists. Tim Berners-Lee, created a server for publishing hypertext, as well as a program for reading it, "WorldWideWeb". And already in 1991, the Internet became available to everyone [1]. The growth rate of the number of connected users in the network:

- October 1969 – in the 2 node network;
- December 1969 – increase of network nodes to 4;
- 1972 – the number of connected nodes is already 37;
- 1981 (12 years since the first message on the network)

– 213 subscribers;
– 1995 – 16 million people online;
– today, the number of Internet users exceeds 2 billion people.

The concept of "social network" was introduced in 1954 by sociologist James Barnes. In the modern sense, a social network is a platform, online service or website for building, reflecting and organizing social relationships on the Internet. In 1995 Randy Conrads created Classmates.com – the first social network. Now there is a huge number of social networks. Below are the most popular types of social networks in the world and in Belarus.

1) Facebook.

Facebook is the largest social network in the world. It was founded on February 4, 2004 by Mark Zuckerberg and his roommates (E. Saverin, D. Moskowitz and C. Hughes). The website was available only to students of Harvard University and since September 2006 – to all users of the Internet. Facebook is one of the most visited websites in the world, with more than 2 billion registered users.

2) Instagram

Instagram is an application for sharing and evaluating photos and short videos with elements of a social network. The number of users exceeds 1 billion. The owner of this service is also Facebook Inc.

3) VKontakte

VKontakte is a Russian social network, similar to Facebook. The creator of network is Pavel Durov. The number of accounts in the network exceeds 500 million now.

4) Twitter

Twitter is a social network for public messaging for Internet users. Created by Jack Dorsey in 2006, Twitter soon gained popularity around the world. It has more than 1.3 billion accounts.

5) Odnoklassniki

Odnoklassniki is a Russian social network that allows you to send messages, share photos, write comments, and more. The network was launched on March 26, 2006, and is currently used by more than 300 million people [2].

The main advantages of social networks are instant search for information on a topic of interest; communication without borders; search for people, leisure time, training, ability to express yourself.

Disadvantages are also present: negative impact on health, personal degradation, internet addiction, a big waste of money, a big waste of time, collection of personal data, risk of falling into dangerous organizations [3].

After studying a survey published on the Internet, conducted among students and teachers, the results can be summarized in the following Table 1.

Table 1. The purpose of using social networks

Goal	Students		Teachers	
	Number of respondents	Result, %	Number of respondents	Result, %
Communication	13	87	2	33
Watching movies	3	20	1	17
Listening to music	6	40	1	17
Searching for information	3	12	4	83
No goal	1	7	0	0

Next, the results of the survey in which teachers and students answered questions about the benefits and harm of the Internet were analyzed. Based on the analysis, the following conclusions can be drawn:

– the least threat is a big waste of time;

– for students, fraud is the most dangerous factor (25%), followed by mental health (22%);

– according to teachers, first of all, social networks cause damage to mental (27%) and physical (26%) health;

– teachers consider the possibility of self-study to be the most significant advantage of social networks (33%);

– students put communication first (30%);

– communication and self-expression are the least important among teachers (20%);

– among students, the ability to express themselves is the least important (4%).

The main result of this study can imply that students and teachers see more benefits than harm in social networks, although they face both the first and the second.

As a final conclusion, we can say that social network can bring considerable benefit to those who use it wisely. To minimize the negative consequences, you need to adhere to certain rules of behavior in the virtual space, monitor the amount of time spent on social networks. People cannot replace real life with virtual life, because reality is much more interesting.

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УДК 811.111:602.6

Bondarenko V., Bostynets A., Lichevskaya S.

Cultivated Meat

Belarusian National Technical University
Minsk, Belarus

Nutrition is one of the most important human needs. Every year the food industry brings millions and millions of dollars in profit to farms, companies, corporations. People spend exorbitant amounts on food. On the check of most people returning from the store, you can find meat products, ranging from cheap sausages to expensive beef and other delicacies. Meat does not grow on trees. Such a branch of agriculture as animal husbandry provides us with meat products. But every year it becomes more expensive. This means not only the amount of land used for raising animals, but also the harm that is done to our ecology, the so-called greenhouse gases, industrial waste, etc. More than 150 million animals die at the hands of humans for food every day.

All these facts gave rise to the idea of cultivated meat or ‘meat from test tubes’. Scientists and entrepreneurs are interested in obtaining a hypoallergenic product that does not differ in taste from real meat, which does not bring environmental problems and losses during production. Nowadays, meat cultivation is expensive. In the future, when the technology is mastered by food concerns, the cost of the product will not exceed the price of ordinary chicken. Bioengineering helped in solving this problem, which made it possible to grow meat on the basis of animal cells under certain laboratory conditions. Since animal cells are required to obtain cultured meat, the product is not vegetarian, in contrast to wheat/soybean substitutes. Despite the possible difficulties,

many investors are ready to invest their money in the creation of artificial meat, such as Bill Gates, Sergey Brin, Richard Branson and others.

Industrial meat production raises not only ethical, but also environmental issues. Moreover, finding a quality meat product on the shelves is a very difficult task. Manufacturers often use antibiotics and hormones in their production, which question the benefits and safety of the finished product. Keeping livestock and industrial production of meat products affects the production of greenhouse gases, the consumption of fresh water, the rational distribution of territories – and this is not a definitive list. Fodder pastures and fields for industrial livestock occupy 30% of the useful land of the entire planet, and vegetable gardens / orchards/ greenhouses and fields occupy only 4-5%. We will have to solve global problems with the ecology and quality of meat in the coming years. Today there are only 2 ways: the creation of meat based on vegetable (peas / soy / wheat) or animal protein [1].

The production of cultivated meat consists of several successive stages, each of which has its own nuances, which must be solved to bring the technology "to mind". Production stages are: 1) selection of cells for production; 2) adding environment and growth factors; 3) placement in a bioreactor; 4) using scaffolds for proliferation [2].

Cultivated meat is nowhere to be found in the public domain. What to do for those who, for whatever reason, do not eat ordinary meat? There are such meat analogues as soy products: schnitzel, tofu, tempeh, lupins, beans and beyond.

This technology will continue to develop, but at what pace it is not yet clear. The pace of its development is primarily influenced by the interest from investors, who can provide financial support to enthusiasts involved in the development of this technology. However, gradual technological development makes it possible to find new methods for improving the

production process of cultivated meat. Research suggests that attitudes will depend on many different factors, but with the right presentation and affordability, consumers are likely to have a positive reaction to ‘test tube meat’ on store shelves.

Thus, after solving the problems that hinder the industrial scale of production, humanity will smoothly switch to the consumption of cultivated meat – in a sense, a healthier and cleaner product, allowing it to move away from traditional production by raising and slaughtering farm animals. This process is most likely inevitable – the population is growing every year, as well as its demands for meat products. It remains to be hoped that this technology will be perfected and put into production before the onset of acute food shortages, and fully satisfy the demands of future generations for meat [3].

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УДК 811.111:599.89

Moskalenko G., Solodkov A., Mishuto K., Lichevskaya S.
The Model of a Perfect Human

Belarusian National Technical University
Minsk, Belarus

Our body has many disadvantages and scientists tried to solve this problem. Anatomist Alice Roberts, anatomical artist Scott Eaton and special effects designer Sangeet Prabhaker took part in making a model of a perfect body. They replaced weak parts of our body with stronger parts of animals.

LEGS AND SPINE

Our legs rest on their toes it makes them stable but not very suited for running. Our ancestors walked on all fours and our spine had the form of a bow. And in general, they never had illnesses connected with spine that we can have nowadays. Our upright posture has positive and negative sides. This type of moving consume less energy than the previous one, also this posture is better for our breathing and digestive system. But it has a big disadvantage: our spine has a form of a column; it has three bends and that put great amount of pressure on our lower vertebras [1]. Now let's turn to our knees: we have the most advanced knuckle between two enormous levers (femur, tibia). That's why our knee can move only in 2 directions and hit from the side will be very destructive and painful. Our feet have very complex structure and many unnecessary bones that are held together with the help of great amount of bunches. This structure is due to our primate past: we needed that to hold on different branches, but now they are not useful. Scientists found solution to all these problems: they paid attention to leg prostheses that were made for professional runner Oscar Pistorius who lost his legs. This type of prostheses is made on

the basis of ostrich legs. They rest on finger and their size bigger than our legs size, they have less complex structure (they consist of only 5 bones). In addition, they perfectly suit for running and give ability to rise high speed at running. Ostrich leg has fewer bones and better distributes pressure, that will not cause any illnesses connected with spine [2].

EYES

The second part are our eyes. Here we have the same situation that we had with our legs: the structure is too advanced and it can be simpler and better. Despite the fact that our eye performs its function well enough, it has a number of imperfections. One of often used arguments of creationists is that our eye is so complex and has so many interconnected parts that it could not be produced by evolution. Evolution is a long, continuous process, it simply cannot produce something brand new, it only can slightly change the existing structure. Actually, the human eye is one of the most studied organs in terms of evolutionary progress (Fig. 1).

All vertebrates have the same design flaw in their eyes: photoreceptor cells of the retina are facing backwards [3]. The nerve side faces the light and the light-sensitive side faces inward. The light must travel through a layer of tissue, blood supply and a bulk of photoreceptor cell in order to be detected (Fig 2). This is also a reason why we have a blind spot. All of these nerves must travel to the other side of the retina to the brain and they all go through a hole in the retina. Cephalopods do not have such a problem. Their photoreceptor cells are facing the right way so light gets directly into photoreceptors (Fig 3). And the optic nerves are connected from the back side of the retina so there is no hole in the retina. Cephalopods have overall better eye structure; they can see a wider range of wavelengths including ultraviolet and infrared light. Their eyes are closer to a camera lens: they are focusing light by moving the lens, rather than deforming it like a vertebrate eye does.

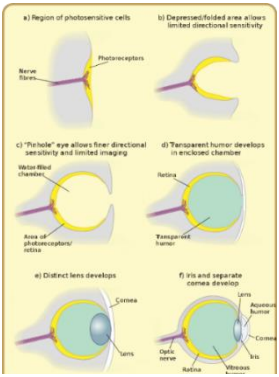

Figure 1 – Eye evolution

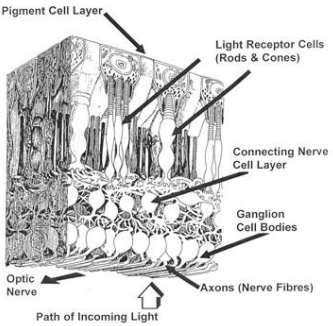

Figure 2 – Vertebrate retina structure

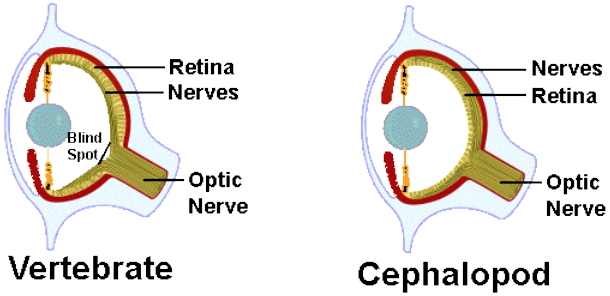

Figure 3 – Vertebrate and Cephalopod eye structure

REPRODUCTIVE SYSTEM

During the evolution our pelvis was changing in two ways: at first it has become narrow, when human started using only legs for movement but then it became more widely for better childbearing, but now it's still too narrow. Pregnancy is too long and child birthing is too painful. Scientists took both facts into consideration and found the solution: after a certain period, a part of baby body will be placed out of mother body and continue the growth [4]. They "stole" this idea from

marsupials. People can adapt to anything, so, who knows what our appearance in the future will be.

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УДК 004.338=111

Borshchevsky A., Getsman E., Matusevich O.

Blockchain Technology in Electricity Distribution and Consumption

Belarusian National Technical University
Minsk, Belarus

What is Blockchain? Blockchain is one of the most promising technologies that have great potential to transform a range of branches of peoples' lives and make them more efficient, faster, and secure. That is to say, blockchain is a database of transactions but it differs from traditional databases as we know them. Talking of traditional databases, data is stored on the main server with a single authority empowered to delete or change the data whereas blockchain data is shared across a network of users. All consumers have special software that ensures all data remains identical. Cryptography guarantees data to be secured and can be edited only by authorized people.

But what is the block? A block is a kind of piece of information that is made up of data. The block contains so-called a time stamp which is used to create the hash of the block. The hash is the unique identity of a block much like the fingerprint of a human being. Every block also contains the hash of the previous block. It creates a chain of interconnected blocks, as it is shown in Figure 1, and gives this technology its name. Every time a new block is added, a time stamp is added to all the transactions.

There are various kinds of data that can be stored at a block. The data can be related to medical records, election information, smart contracts, or land records. And this technology has found its usage in power engineering as well.

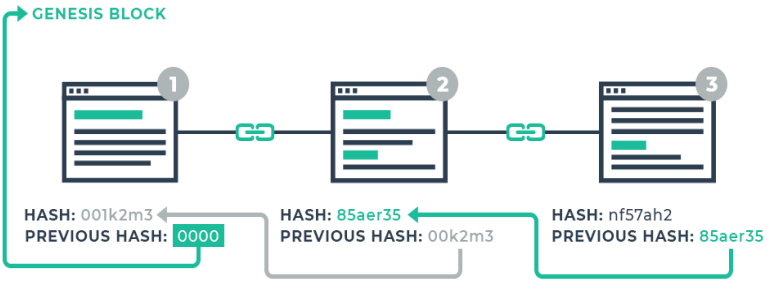

Figure 1. The Chain of Interconnected Blocks

The Usage in Current Power Grids. The current market of energy trade has a centralized structure. Blockchain-based trading infrastructure can offer Peer-to-Peer (P2P) trade which means a decentralized secure organization of electric energy sale between consumers and prosumers (Figure 2). A consumer would be allowed to register as a prospective buyer and a prosumer as a prospective seller. In fact, the UK based Energy Networks Association has plans to invest the amount of 17 billion € in the local energy markets using the smart grid [1].

In P2P trade the block structure consists of the Block ID (unique identification), header, transaction and lock time, which plays the role of time indicator when that particular block was added into the network. Transaction part is generated after the request of the buyer. It consists of Transaction ID (TID), Meter ID (MID), Amount of Energy Requested (AER), Amount of Energy Granted (AEG) for the requesting buyer by the supervisory nodes based on the available energy from the sellers, Energy coins Transferred (ET) by the buyer for the transaction, Digital Signature of the Seller (DSS) indicating a successful transaction, and Digital

Signature of the Processing node (DSP) indicating validation of the transaction.

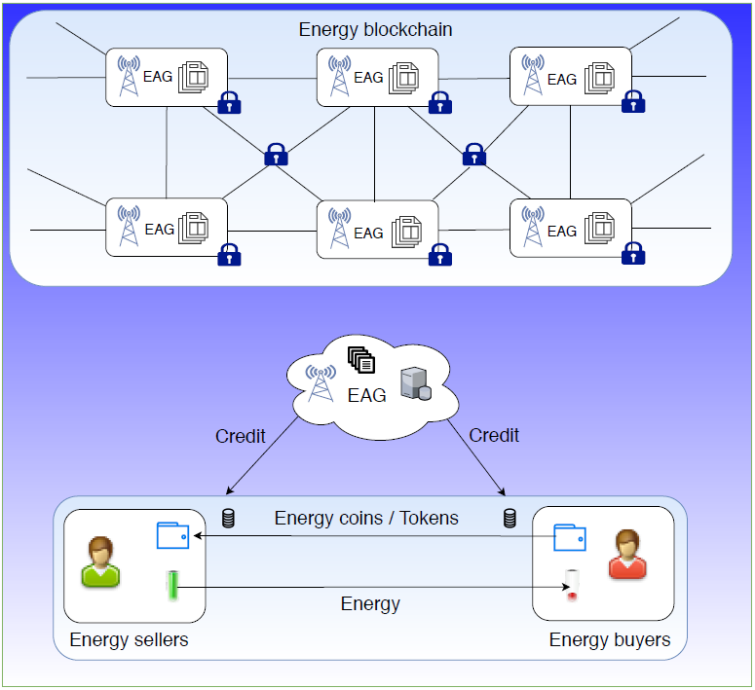

Figure 2. Architecture for P2P Energy Trading

It also includes time stamps indicating Time of Request (TR) and Time taken for Transaction (TT). In other words, it contains all specific data for each transaction [1].

At the same time, blockchain technology has potential applications such as:

1) Automation of billing for consumers and distributed generators;
2) Improvement of the control of decentralized energy systems and microgrids;
3) Potential use for communication of smart devices, data transmission or storage [2];

4) Assistance to grid management;
5) Simplification and speed up of switching of energy suppliers by smart contracts;
6) Protection of transactions and secure data privacy;
7) The auditing and regulatory compliance's improvement.

Potential Challenges. During the process of implementing this technology into current grids there will be several issues and doubts that must be tackled:

1) A need for reinterpretation of a considerable number of aspects of the law;
2) Can the applications be made that match the inherent security of the blockchain?
3) Challenges of legacy infrastructure and technical understanding.

On the whole, blockchain is prospective technology for the digitalization of the current distribution and consumption of electric energy. It will allow the current energy market to increase the efficiency, safety, and management level of power grids. Anyway, there are several problems which must be solved in order to transform the whole system.

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УДК 620.91=111

Bulin M., Borshchevsky A., Matusevich O.

Sun and Wind Power

Belarusian National Technical University
Minsk, Belarus

The energy appetite in our cities of the 2020s is growing all the time. Millions of home appliances require electricity to work. Transportation, communication, and the many developments of modern technology consume a lot of energy. Satisfying these appetites requires vast amounts of fossil fuels. Fossil fuels such as coal, natural gas, and oil were formed from the remains of animals and plants deep within the earth over millions of years. These fuels are burned to heat homes. They are also burned to heat water and produce steam. This steam turns the turbines of generators that produce most of our country's electricity.

People are using up fossil fuels at tremendous rates. Other sources of energy are being developed to replace the dwindling fossil-fuel supply. In this article you will see how energy from the sun is being used in place of fossil fuels.

Solar Heating and Cooling. The sun is a huge and largely untapped source of energy. The energy in sunlight shining on the territory correlated to the US in one day could power this country for a year. However, most of the sun's energy is reflected back into space or absorbed by the upper layers of the Earth atmosphere.

Science and technology are working together to find new and better ways to use energy from the sun. Solar energy is being applied for heating and cooling homes. Use of solar energy can conserve fossil fuels and reduce air pollution.

Solar Heating. As we know, originally there were two

ways of applying solar energy in house heating. In one house, solar energy was collected and stored in drums of water. In the other house, it was collected and stored in stone walls. The solar-heated house absorbs heat from the sun by using collector panels. These panels have black energy-absorbing surfaces covered with glass or clear plastic. They are attached to pipes that circulate air or water throughout the house. The dark surfaces of the panels absorb solar energy and heat the air or water in the pipes. The heated materials transfer energy throughout the building.

Solar energy must be stored for use at times when it cannot be collected. Tanks of water and beds of large pebbles are two common methods of storage [1].

Solar Cooling. Energy is required to run air conditioners. Most of them get this energy from electricity. The energy runs a refrigeration generator. The latter cools air by evaporating and then condensing a circulating liquid refrigerant.

Solar energy can supply the energy needed to run an air conditioning system. The world first solar heating and cooling system was created in 1975 and then installed in elementary school in Atlanta, Georgia [2].

Solar Panels Are Mounted on the School's Roof

In the Mohave Desert in California, a solar power plant is in operation. The plant, known as Solar One, is a 30-story tower surrounded by almost 2,000 flat mirrors. Each mirror, which turns to face the sun throughout the day, reflects sunlight to the tower. Water circulating through pipes in the tower is heated to 515º C and turned into steam. The steam then turns a turbine that generates electricity. Solar One has already met its goal of producing 10 million watts of electricity. Other, more efficient, solar power plants are being proposed for California, Arizona, and Texas [3].

Wind Power. The wind is really a form of solar energy. It is produced by the uneven heating of the earth by the sun. About 2% of solar energy is changed into wind energy. Using wind energy to do work is not a new idea. Many centuries ago people began using wind to sail ships. And they started using wind-driven mills to grind grain.

Figure 1. Old and New Windmills

The windmill you see in Figure 1 can be used to do work. A windmill is a shaft with blades that turn in the wind. Wind energy does work when it turns the blades.

Windmills like the old one in Figure 1 were used on many farms to pump water or grind grain. Some were used to turn turbines that generated electricity. Later wind generators fell out of use. They were replaced with generators that harnessed coal and water power to produce electricity.

Today scientists are designing large windmills like the new one in Figure 1. The wind blows the propeller, or turbine, which runs an electric generator. The larger the propeller, and the faster it turns, the more electric energy it generates.

Wind energy is clean and, of course, free. But wind-driven generators are expensive. And they can produce electricity only when the wind blows. Some people also object to the noise and the appearance of these large machines. The electric power from windmills is not great enough to supply our energy needs. It can save on fossil fuels. However, other sources are still needed to satisfy the demand for energy [4].

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УДК 537.876.2=111

Kovalets I., Korshun V., Matusevich O.

Electromagnetic Waves in Space

Belarusian National Technical University
Minsk, Belarus

The universe is full of stuff: heavy stuff, light stuff, hot stuff and cold stuff, but what about the stuff you can't see or touch? You may already be familiar with some of the uses of electromagnetic waves. Microwave ovens cook food. Ultraviolet rays kill germs. Infrared "heat lamps" help soothe aching muscles. But electromagnetic waves have other uses with which you may not be so familiar. This article will present their use in space and other areas.

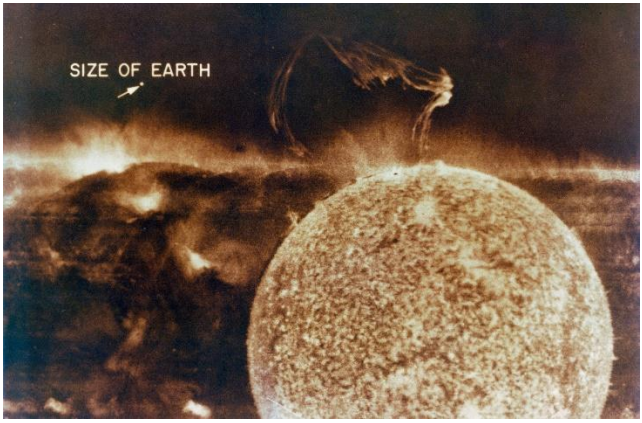

Figure 1. The Ultraviolet Photo of the Sun

Before space flight, astronomers could only study the universe with ground-based telescopes. These instruments were sensitive only to visible and radio wavelengths. Nowadays, rockets carry telescopes outside earth's atmosphere. These

tools have taken photos of the sky in all wavelengths, from radio waves through gamma rays. Figure 1 displays an ultraviolet photograph of the sun that gives information not available in other kinds of photographs. Photographs like this one have helped astronomers learn about the composition of the sun's atmosphere [1].

Astronomers also study the sky in the infrared region of the electromagnetic spectrum. The infrared photos in Figure 2 show jets of gas being emitted by a quasar. Quasars appear to be galaxies moving away from the earth at nearly the speed of light. By studying the infrared photographs, astronomers measured the speed of these jets of gas.

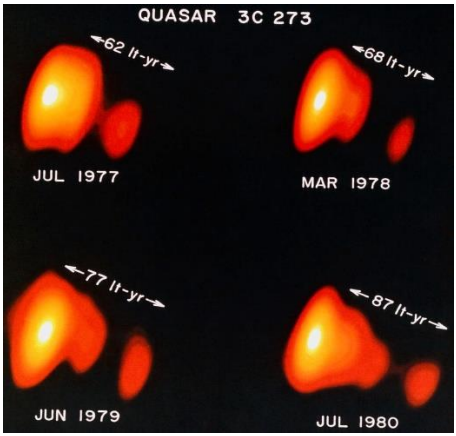

Figure 2. Jets of Gas Being Emitted by a Quasar

Characteristic patterns like fingerprints within the spectra allow astronomers to identify an object's chemical composition and to determine such physical properties as temperature and density. NASA's Spitzer Space Telescope observed the presence of water and organic molecules in a galaxy 3,2 billion light-years away [1]. Viewing our Sun in multiple wavelengths with the Soho satellite allows scientists to study and understand

sunspots that are associated with solar flares and eruptions harmful to satellites astronauts and communications here on the earth. Specialists are constantly learning more about our world and universe by taking advantage of the unique information contained in the different waves across the electromagnetic spectrum [2].

Scientists have built a device that amplifies light, a laser. The latter concentrates a great deal of energy into a narrow beam of light that does not spread. A laser produces a pencil-thin beam of light that travels in one direction. This property makes laser light quite different from light from a lightbulb or from the sun. Ordinary light spreads out in many directions as it travels. Laser light also differs from other light because of its wavelengths. Light from a glowing object is made of a range of wavelengths. For example, the light from the sun is yellow. But you know that it also shines in the ultraviolet, infrared, X-ray, and so forth. Light from a laser, on the other hand, contains a very narrow range of wavelengths. So a laser may emit light only in the infrared or visible or ultraviolet.

To understand how a laser works, think about the electrons in orbit around an atom. Refer to Figure 3. When an atom absorbs energy, an electron moves to a higher energy level. Very quickly the electron returns to its original energy level. As it drops down, it releases a photon of light. This photon then interacts with an electron from another excited atom, causing it to jump to a lower level. Another photon emitted, with the same wavelength as the first.

The process is repeated over and over. As more photons are released, the light builds up, or amplifies. The released photons travel back and forth along rod. They reflect off a mirror at each end. However, the light in the rod soon becomes strong enough to pass through the thinner mirror at one end. An intense beam of laser light is then emitted.

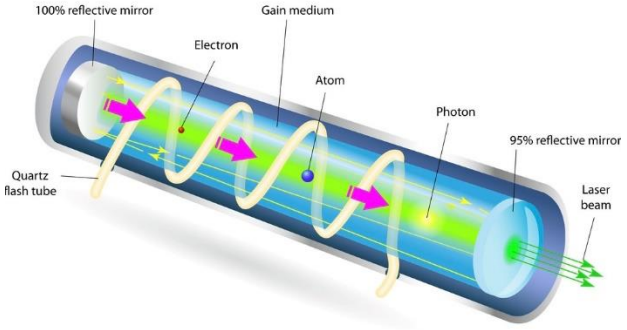

Figure 3. Laser Diagram

The unusual properties of laser light make lasers very valuable. Laser light does not spread out like normal light does. So laser light can be focused to a pinpoint. The focusing also concentrates the energy of the light into a point. Very high temperatures are produced. Industry uses this property of laser light to melt extremely hard materials.

The behavior of an electromagnetic wave in a substance depends on its frequency or wavelength. The differing behaviors of various groups in the electromagnetic spectrum make them suitable for a range of uses [2].

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УДК 004.338=111

Borshchevsky A., Bulin M., Matusevich O.

P2P Energy Trade: a New Vision of Energy Management

Belarusian National Technical University
Minsk, Belarus

What is P2P Energy Trading in General? Peer-to-peer energy (P2P) trading is the system of purchase and sale of electricity between two or more grid-connected parties. In this structure, any excess energy (for example, solar or wind power) can be transmitted and sold to other consumers using a special trading platform. This technology opens new opportunities for all grid participants, such as choosing whom they sell electricity and from whom they will buy it.

Currently, excess solar energy is exported back to the grid for a small feed-in tariff rate. However, this method is becoming obsolete as more people are looking for flexibility and control in managing how their resources are distributed. As mentioned before, the purchase of electricity is made through a special secure platform that is based on blockchain. Due to this blockchain technology, all purchases will be secure and resistible to cyberattacks.

How It is on the Sketch and in Real Life. Two main reasons why the P2P model was invented are the construction growth of distributed energy resources, like solar panels and wind power plants, connected to electric grids, and the further promotion of this process. Thanks to this technology, prosumers can change their roles in a trade process. On the one hand, they can sell electric energy to other consumers directly and can have a profit during relatively high tariffs and the relatively low buy-back ones. On the other hand, buyers can

save costs while sellers can make a profit [1]. The schematic structure is shown in Figure 1.

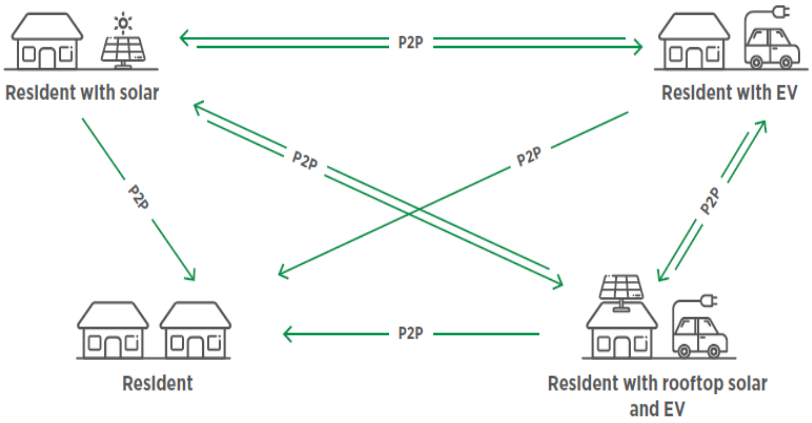

Figure 1. P2P Energy Trade Structure

In order to compare how it is realised in the real life, we will take the Brooklyn microgrid in Figure 2 as an example. On the one side of President Street smart meters count the whole amount of energy, produced by solar panels, and this information is stored on a decentralized blockchain [2]. On the other side of President Street there are homeowners, who play the role of consumers, have an interest in buying electricity from neighbours. The whole trading process is based on the cryptographically secure decentralized application platform Ethereum. As the result, citizens who live on the consumer side can be supported by energy supply from prosumers.

The LO3 company is now developing an application that will give the opportunity to monitor and transact their excess production based on personal preferences. At the same time prosumers will be able to control solar panels, batteries and building loads with the help of this app.

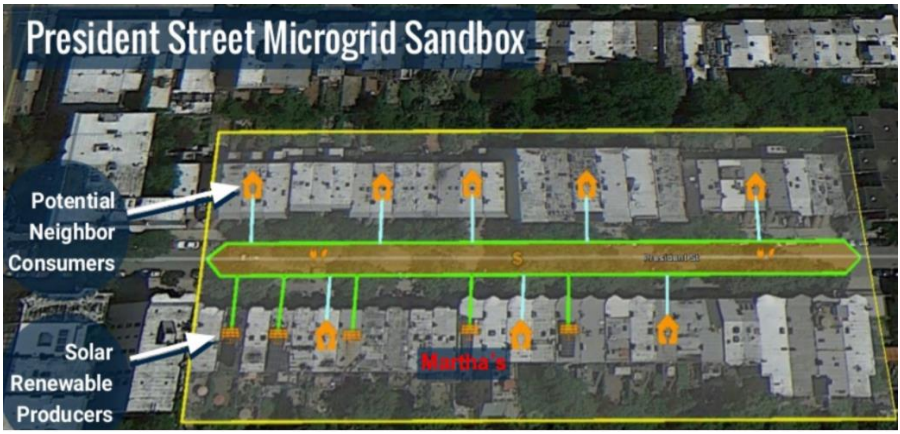

Figure 2. Brooklyn Microgrid

This project is a vivid example of how rapidly green energy and digital technologies are changing the traditional way of relations between electric producers and consumers. Moreover, there are projects in Australia where blockchain was implemented into electricity trading between residents. It's worth mentioning that in Germany there is a huge network of about 8,000 customers, who can trade stored energy with each other.

Technology's Advantages and Challenges. Potential contribution to the electric grids' development can't be overestimated. There is a list of them:

1. Provision of a choice for dealing with different consumers and cutting out electricity retailers;
2. Reduction of electricity transportation costs;
3. All transactions are public and can't be altered that makes the whole process secure;
4. Widening possibilities for renewable energy deployment;
5. Provision of ancillary services to the main power grid;

6. Improved energy access for consumers in mini-grid set-ups.

At this time, there are still potential challenges that slow down the process of integration P2P trade in the energy sector:

1. Probable governments' loss of control over energy systems can be an obstacle for them to keep authority to implement better policies and regularization;
2. It requires costly appliances such as smart meters, which can also increase costs;
3. Transactions become a part of the blockchain after initial computation, and this can be a long process [3].

On the whole, P2P trade can change the whole vision of energy trade. It can significantly reduce overall operation costs of the power system and reduce consumers' electricity bills. At the same time, a big work must be done in order to achieve all these goals in the future.

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УДК 620.91=111

Bulin M., Getsman E., Matusevich O.

Solar Energy Statistics Review

Belarusian National Technical University
Minsk, Belarus

In modern realities, there is a heightened interest in the use of alternative energy sources, in particular the primary energy of the sun, water and wind. In the foreseeable future, the use of most fossil fuels as energy sources will become very expensive and problematic due to the likely increase in the cost of fossil resources because of their reduction in volumes and unprofitability of extraction. In this article we will review the main aspects of solar energy and the dynamics of industry development, its future prospects, potential and characteristics.

Solar energy is the sphere of alternative energy based on the direct use of solar radiation to generate power. Solar energy uses a renewable energy source and in addition to this it is environmentally friendly, so it doesn't produce detrimental waste during the active phase of use. Energy production from solar power plants is well aligned with the concept of distributed energy production, smart grids, etc.

The sun emits 3.8×10^{23} kilowatts (kW) of energy per second. But only a tiny amount, roughly 1.8×10^{14} kW is intercepted by the earth, is about 150 million km from the sun. However, only 60% of this volume or 1.08×10^{14} kW reaches the surface of the earth. The rest is reflected back into space or absorbed by the atmosphere. That's why even if only 0.1% of this potential energy would be converted at an efficiency of 10% it would be four times total generating capacity of nearly 19.4 terrawatt-hours (TWh). Taking this fact into consideration

we can confidently claim that solar energy would be quite promising, especially if the technological progress allowed [1].

In recent years, the transition to renewable energy, especially solar power, has become increasingly noticeable, so in 2005 the share of renewable energy accounted for solar power was 0.1%. Then in 2010 it was raised to 0.8%, and in 2018 soared to 8.3% (See Table 1).

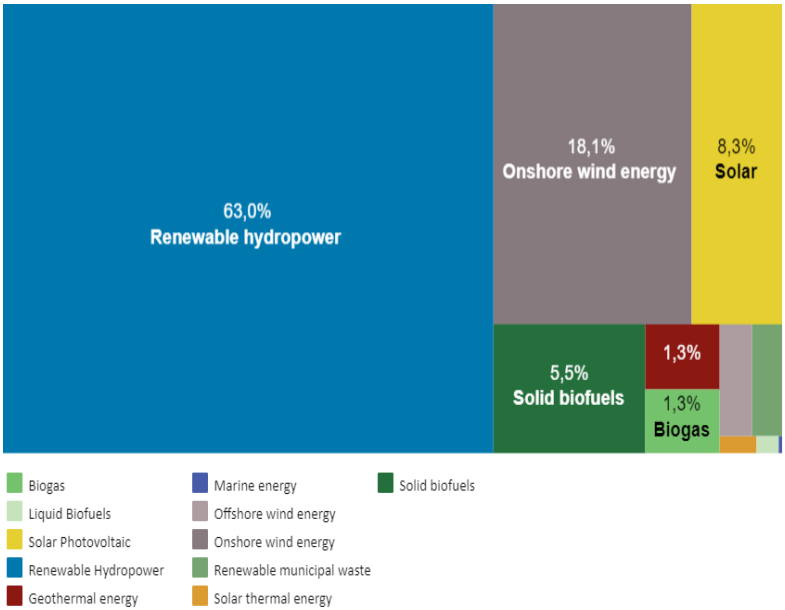

Table 1. Renewable Energy Generation Ratio in 2018

The technology is the most attractive for investors due to its inexhaustible and promising potential, so in 2013-2018 solar photovoltaic (PV) and onshore wind power technologies consolidated their dominance, attracting, respectively, 46% and 29% of the world's renewable energy investments over the five-year period. Considering ample resource availability, significant market potential and cost competitiveness, PV

technology is expected to continue driving overall renewables growth in several regions over the next decade [2].

In the first days of solar cells in the 1960s-1970s more energy was required to produce a cell than it could generate during its lifetime. Since then significant improvements have taken place in their efficiency and manufacturing methods. It's estimated that the total installation cost of solar PV projects would continue to decline dramatically in the next three decades, reaching the range of USD 340 to USD 834/kW by 2030 and USD 165 to 481/kW by 2050, compared to the average price of USD 1,210/kW in 2018 [3].

At a country level, the average total installed cost of utility-scale solar PV projects has declined by between 66% and 84% in major markets during the period of 2010 to 2018. Germany and France witnessed a reduction of 71%, while others have experienced reductions closer to 80%, such as China and Italy (77% and 78% respectively). India was estimated to have the greatest reduction, estimated at 80% [3] (See Table 2).

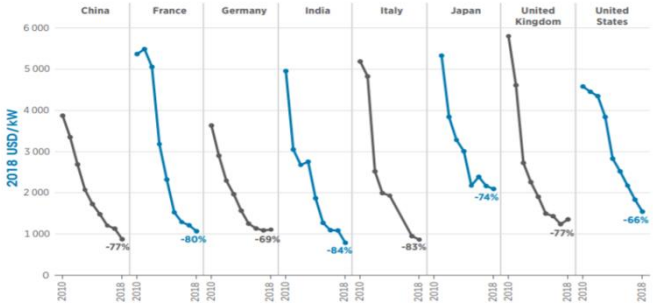

Table 2. Total Installed Cost of Utility-Scale Solar PV

For instance, if we talk about Belarus according to the local law, the state is obliged to connect devices that produce energy from renewable sources to the general grid and

purchase energy from them. In the case of solar energy, the purchase price is three times the price for which energy is sold to consumers. However, as a rule, low-efficiency solar power plants are installed by private enterprises of various forms of ownership for personal consumption with partial consumption from the grid or without electricity use of the general grid at all. The power of such stations rarely exceeds 500 kW.

To sum up, the use of solar energy is an inexhaustible source of electricity, which in the future will take a large part of alternative generation. The industry has attracted considerable interest from investors, and the cost of installation has decreased significantly between 2010 and 2018. Over the same period, the power factor increased from an average of 14% to 18%.

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УДК 620.95=111

Klimchuk S., Matusevich P., Matusevich O.

Fossil Fuels

Belarusian National Technical University
Minsk, Belarus

The term «fossil fuels» is usually used to define a number of substances of organic origin that were formed from organisms and plants nearly 340 to 270 million years ago even before the age of dinosaurs. At those times the swamps inhabited by many different microorganisms and filled with plants occupied a significant part of the land. Dead plants sank to the bottom of swamps and seas and subsequently underwent a long process of decomposition that lasted millions of years. The formation of a particular type of fossil fuels depends on a number of factors: the combination of organic materials involved in the process, climate, pressure, temperature, and, of course, time [1].

Oil, Coal and Natural Gas

There are three main types of fossil fuels, such as coal, oil and natural gas.

Plants, especially ferns, and trees which hardened due to pressure and heat are the basis of coal. Oil is a natural, thick, flammable liquid of dark color with a specific smell. It was formed from small organisms like zoo plankton, and algae where pressure caused the more complex organic matter to decompose. Natural gas is colorless and odorless. It was formed by the same process as oil, only it was exposed to more heat and pressure forcing it to transform later and turn into a gaseous form [2].

Initially, the development industry preferred such fossil as coal. It is a solid substance that is relatively easy to mine and transport. Only at the end of the XIX century the popularity of oil began to grow. It is much difficult to get it, but you can also receive more energy from it. In the XXI century gas is the most common energy resource. Its important advantage is environmental friendliness.

Furthermore, fossil fuels are sought after energy sources because they have a high energy density. They are the world's key energy source. Fossil fuels provide around 80% of the world's electrical power, and 95% of the world's total energy demands (including heating, transport and electricity generation) [3]. They can also be used to make a variety of common products from plastics to cosmetics not to mention even some medicines.

So why are fossil fuels such an influential, but ultimately problematic, source of energy? It has taken hundreds of millions of years for nature to create enough of the special conditions to form the fossil fuels we use. That’s why fossil fuels are considered non-renewable resources. It means that once they are used, the resources will not be replenished in a human lifetime.

But there is a bigger problem with fossil fuels. As we have seen, primarily they are made of carbon, and when we burn them, oxygen is added and that makes CO_2 that goes in the air. And we are reversing the process by which they formed. And if we keep doing this, it must change the composition of the Earth's atmosphere.

CO_2 Goes in the Air

A greenhouse gas which causes climate change in addition to their production causes both environmental and human health issues. Now let's have a look at pros and cons of fossil fuels.

Advantages:

1. Fossil fuels are the fuels with high energy potential;
2. The transportation of fossil fuels isn't difficult;
3. Power plants, fueled by natural gas, have a relatively high efficiency;

4. The location of power plants that use fossil fuels as the main combustible does not depend on the area of the fossil fuel deposits.

Disadvantages:

1. It is harmful to the planet's ecology because the burning of fuel produces so-called greenhouse gases.
2. Open-pit coal mining is a dangerous and difficult business. It destroys large areas of the natural landscape.
3. Due to the high fuel consumption of power plants, it is necessary to ensure the uninterrupted flow of the required amount of fuel. For this reason, a large area near such facilities is occupied by fuel depots, since the costs of starting and stopping the power plant are big. This is applied mainly to power plants that use coal as fuel.

These concerns have triggered society to look at alternative sources of energy that are more environmentally-friendly, sustainable and renewable.

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Kovganov Z., Kakorina A., Matusevich O.

The Third Law of Motion

Belarusian National Technical University
Minsk, Belarus

«What goes up must come down». You may have heard this description of gravity. Yet when you jump on a trampoline, the reverse is also true. "What comes down must go up." How can a trampoline make you move up against gravity? This article will help you answer this question. You will take a close look at what happens when one object applies a force on another. Moreover, you will learn about a give-and-take between the two objects.

As you fall onto a trampoline, you apply a downward force that stretches the trampoline. The trampoline, then, applies an upward elastic force on you. It is this upward force that bounces you back up.

In short, a pair of forces is at work here. You apply a force to the trampoline. And the trampoline applies a force on you. The forces are opposite in direction. But they are equal in amount. The greater the downward force you apply on the trampoline, the greater the upward force it applies on you.

Forces always act in pairs. Each force in a pair acts on a different object. For example, when you use a finger to push a book, the book also pushes your finger. If you push a friend while you are both on skates, you are pushed as well. Your friend accelerates in one direction and you accelerate in the opposite direction. In each case, one object (or person) applies a force to the other.

Sir Isaac Newton made similar observations about pairs of forces. Newton summed up his observations in his Third

Law of Motion. This law states that for every action there is an equal and opposite reaction [1]. Your finger pushing a book, for example, is an action. The book pushing your finger is the reaction. The action force is equal in strength to the reaction force. But the two forces act in opposite directions.

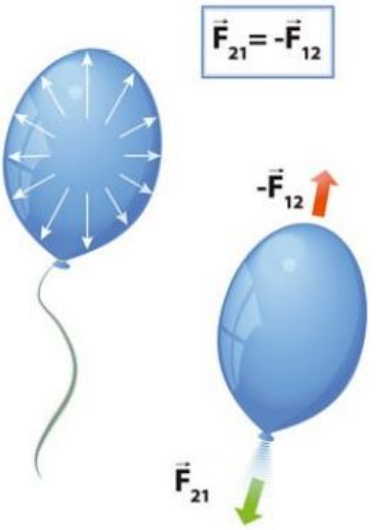

Figure 1. Pairs of Forces Acting on a Balloon

Compare the forces of action and reaction in Figure 1. The balloon applies an elastic force, an action force, on the air inside. The action force pushes the air out. The air, in turn, applies a reaction force on the balloon. The reaction force pushes the balloon in the opposite direction.

See Figure 2. A rocket is launched by a similar kind of reaction force. A rocket engine produces gases. It applies an action force that pushes the gases downward. The gases, in turn, apply a reaction force on the rocket. They push against the rocket, causing it to lift up.

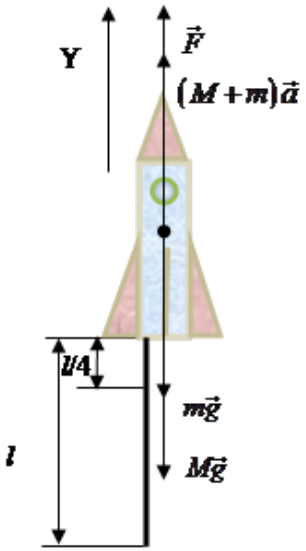

Figure 2. Pairs of Forces Acting on a Rocket

A variety of action-reaction force pairs are evident in nature. Consider the propulsion of a fish through the water. A fish uses its fins to push water backwards. But a push on the water will only serve to accelerate the water. The size of the force on the water equals the size of the force on the fish; the direction of the force on the water is opposite the direction of the force on the fish. For every action, there is an equal (in size) and opposite (in direction) reaction force. Action-reaction force pairs make it possible for fish to swim [1].

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УДК 620.9=111

Ryngel V., Hatkevich R., Matusevich O.

Different Forms of Energy

Belarusian National Technical University
Minsk, Belarus

There are very many forms of energy, such as electric energy, chemical energy, and light energy. Each of these forms of energy can be thought of as either potential energy or kinetic energy. After examining the various forms of energy, it is important to remember two things. First, whenever a change occurs in nature, energy changes from one form into another. Second, energy is always conserved. The total energy in an object, or in a group of objects, remains the same. Energy cannot be seen or measured directly. However, the energy an object has may be determined from things that can be seen and measured. In this article we will explore the ways energy can be measured. One way to determine the amount of energy an object has is to investigate the changes it causes. If a small marble falls from a height of 10 centimeters (cm) onto your finger, it produces only a small change in your finger. However, if you drop the same marble from a height of 5 meters (m), the change is much greater. Your finger hurts! The change depends on the potential energy of the marble. The higher an object is, the greater its potential energy. If you replaced the marble with a heavy bowling ball, the changes in your finger would be very large indeed. The potential energy of an object depends on two things that can be measured. It depends on the weight of the object and on its height. The weight of an object, in turn, depends on the force of gravity. For this reason, the potential energy is called gravitational

potential energy (GPE). It is the potential energy an object has due to its position above the earth's surface [1].

A moving object can also cause changes. Imagine your finger is pressed against a wall close to the floor. A marble rolling across the floor hits your finger. The changes in your finger depend on the marble's speed. The greater the speed is, the greater the changes. The kinetic energy depends on the speed of the object. But what would happen to your finger if a slow-moving bowling ball banged into it? Quite a change! Remember, kinetic energy depends on both the mass and the speed of an object.

Moreover, energy is important because it is conserved. The total energy in an object, or in a group of objects, always remains the same. The total energy is the sum of the different kinds of energy an object has. As the roller coaster in Figure 1 starts its run, it has only GPE. What happens to the energy of the roller coaster system during the ride? You know the total energy must stay the same. The energy just changes from one form to another.

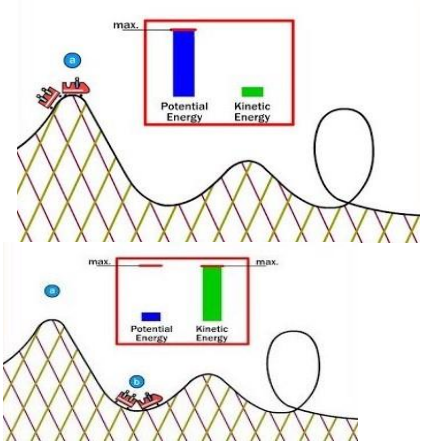

Figure 1. Conservation of Energy of the Roller Coaster System

On the way down the roller coaster loses potential energy and gains kinetic one. At the lowest point during the ride, the roller coaster has the greatest speed. So it has the greatest kinetic energy. But at the same time it has the least potential energy. However, the total energy remains constant. As the roller coaster bumps, rubs, and grinds against the rails, heat energy is produced. It means that when the heat energy increases, the kinetic energy must decrease. If you add up the potential, heat, and kinetic energies anywhere during the ride, you always get the same answer.

Energy Conversion. Have you ever wondered, what happens to you when you go up? Look at Figure 2. You gain potential energy every time you walk up stairs. Your muscles pull your body against the force of gravity, doing work. In theory, the potential energy your body gains as you climb is exactly the same as the food energy it loses: one form of energy is simply converted into another. (In practice, you need to use more energy than you might think because your body wastes quite a lot of energy in the process).

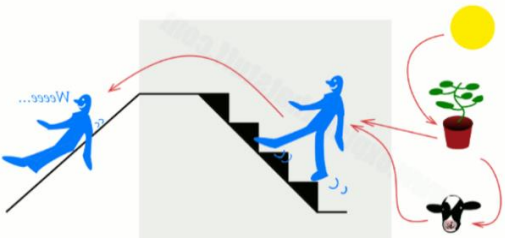

Figure 2. Physical Meaning of Energy Conversion

At the top of a flight of stairs, you could turn your stored potential energy back into kinetic energy (movement) in various ways, such as sliding down the banisters or jumping down a fireman's pole! You can trace every bit of energy your body uses back to the food you eat, which comes from animals and plants and ultimately from the Sun.

Energy Conversion Technology. Energy conversion technology refers to any system that converts energy from one form to another. Energy can be described in many ways, with different forms of energy including heat, work, and motion. Moreover, potential energy can be in the form of nuclear, chemical, elastic, gravitational or radiant energy. All of these can be converted into useful energy, with the one of the most common and versatile forms being electricity. The main goal of power plants is to take a fuel like coal, natural gas or uranium, and transform it into electricity. This makes power plants an energy conversion technology, and they are the largest energy conversion technologies by far.

In fact our own bodies are extremely complex conversion technologies. They take chemical energy from food and convert that into different forms of mechanical energy that we need in order to operate. Our body can then use this energy to convert into many other forms: heat, movement, sound, gravitational potential energy, etc.

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УДК 620.9=111

Voitovich S., Govrov A., Matusevich O.

Work and Energy

Belarusian National Technical University
Minsk, Belarus

We hear and use the word “work” many times each day. People go to *work*. We do our math home*work*. You *work* on your bicycle. A sculpture is a *work* of art. In each case the word “work” has a different meaning.

In physical science, however, work has only one meaning. When we do work, we exert a force through a distance. For example, the people who are walking are doing work. They are using a force to move a certain distance. You do work when you try to fix a part on your bicycle. The sculpture itself is not doing work. But the person applying the chisel certainly is. In this article we will find out more about work in its scientific sense.

Energy is a word we have heard and used many times. People already have a good idea of what energy is. For instance, we know that a blasting off rocket has a lot of energy. It means that a high-speed truck has plenty of energy. A basketball player needs a lot of energy to play the entire game. We need energy to do work. That is why we must eat a good breakfast each day. Machines also need energy to do work. Whenever work is done, energy is used.

Work. How can we tell when work is being done? For work to be done, a force must be applied to an object. The force must cause a change. Look at the people in Figure 1. Are either of them doing work?

Figure 1A shows a girl trying to lift a 500-N barbell off the floor. Although she exerts a force, the barbell does not

move. Since there is no change, she is not doing work. The girl in Figure 1B, however, does do work in lifting the 100-N barbell to her knees. She does more work as she lifts the barbell to her chest and as she presses it over her head. She did work because in each case the force exerted on the barbell made it move a certain distance.

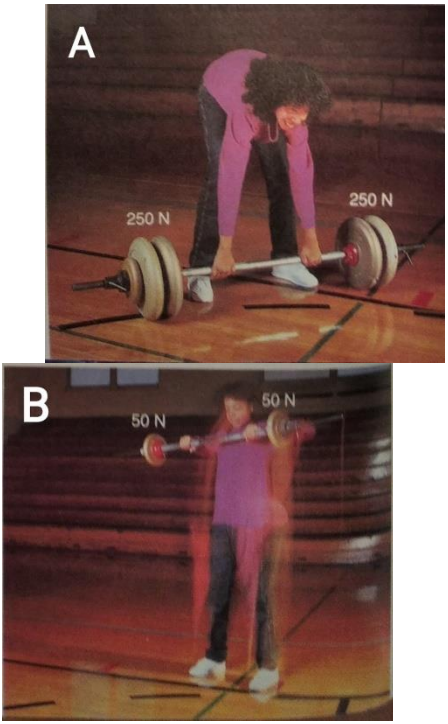

Figure 1. People Try to Do Work

It is worth mentioning that to do work we have to apply a force. We must make the object move in the same direction as our force. In fact, work is defined in these terms. Work is the amount of force exerted on an object times the distance the object moves [1]. As the boy lifts the barbell, he does work on the barbell. But is he doing work if he simply carries the

barbell across the room? See Figure 2. In the scientific sense, he is not doing work. The direction of the applied force (up) is not the same as the direction of motion (to the right).

Notice that work does not involve time. All that matters is what force is exerted on the object and what distance the object moves. Once the boy presses the barbell over his head, he does no further work on the barbell. He does no work even if he holds it there for an hour.

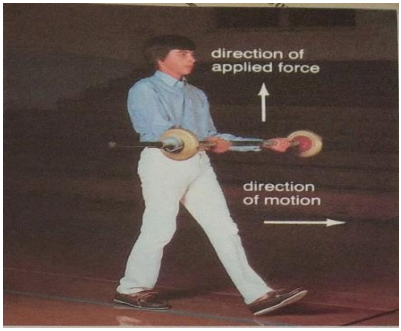

Figure 2. The Boy Does Work

Energy. Suppose we lift a super-hard ball a distance of one meter. When we release the ball, it falls. It gains speed until it hits the floor. After the ball hits the floor, it bounces back up.

The ball's motion is complex. The height and speed of the ball keep changing. These changes occur because the ball has energy. Energy is the ability to cause changes in matter. These changes are possible because you did work on the ball by lifting it. The more work you put into lifting the ball, the more energy the ball gets. Energy comes in many forms. Some of the many forms of energy are chemical energy, mechanical energy, and light energy. See Table 1 for other forms of energy.

Form of Energy	Source
Atomic	radioactive materials
Chemical	batteries
Light	the sun
Mechanica	machines
Sound	vibrations

Table 1. Forms of Energy and Their Sources

All the different forms of energy can be divided into two basic kinds. These kinds are potential energy and kinetic energy. Potential energy is stored energy. The energy in a wound-up rubber band is potential energy. So is the energy of a person on a high-dive platform. All these objects have potential energy because work was done on them to put them in their present state. Kinetic energy is the energy of motion. When the rubber band is released, the plane's propeller spins and the toy flies. The toy has kinetic energy. When the swimmer dives off the platform, she has kinetic energy. Potential energy and kinetic energy are related. As one decreases, the other increases. This relationship is the basis of a very important law about energy.

We observe changes all the time. Balls bounce, bicycles roll down hills, batters hit baseballs high into the air, and children swing on swings. Energy changes from one kind into another. As the swimmer dived, she lost potential energy. At the same time, she gained kinetic energy. The total energy of the diver is her potential energy plus her kinetic energy. But the total energy of an object does not change! The total energy remains the same. This is an important pattern in nature called the conservation of energy. The Law of Conservation of Energy states that the total energy of an object, or of a group of objects, stays the same [2].

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Chistov P., Lukashevich K.

Information and Measurement System

Belarusian National Technical University
Minsk, Belarus

An information and measurement system (IMS) is a set of functionally integrated measuring, computing and other auxiliary technical means for obtaining measurement information, converting it, processing it in order to present it to the consumer in the required form, or automatically performing logical functions of control, diagnostics, identification, etc.

Depending on the functions performed, IMS are implemented in the form of measurement systems (MS), automatic control systems, technical diagnostics, etc.

In turn, depending on the purpose, measuring systems are divided into measuring information, measuring control, measuring control systems, etc.

Measuring system (MS) - a set of measuring instruments (measuring transducers, measures, measuring switches, measuring instruments) and other technical devices (components of a measuring system), which form measuring channels, which implements the measuring process and provides automatic (automated)) obtaining measurement results (expressed by a number or a code) in the general case of time-varying and distributed in space quantities that characterize certain properties (state) of the measurement object.

The largest structural unit for which metrological characteristics (MC) can be normalized is the measuring channel (MC) of the MS

The measuring channel of the MS is a structurally or functionally allocated part of the MS that performs a complete function from the perception of the measured value to the receipt of the result of its measurements, expressed by a number or a corresponding code, or to the receipt of an analog signal, one of the parameters of which is a function of the measured value [1].

It is a serial connection of the SI forming the MS (some of these SI themselves can be multi-channel, in this case we should talk about the serial connection of the MS of these SI). Such a SI connection, provided for by the functioning algorithm, performs a complete function from the perception of the measured value to the indication or registration of the measurement result, inclusive, or converting it into a signal convenient for further use outside the MS, for input into a digital or analog computing device that is part of the MS, for joint conversion with other values, for influencing the actuators.

A typical MC structure includes a primary measuring converter, a connecting component of the measuring system (a technical device or part of the environment intended or used for transmitting signals with minimal possible distortion that carry information about the measured value from one MS component to another (a wired communication line, a radio channel, a telephone communication line, a high - voltage power line with the corresponding channel-forming equipment, as well as transition devices-terminal blocks, cable connectors, etc.)), an intermediate (unifying) measuring converter, analog-to-digital converter, processor, digital-to-analog converter.

There are simple MC that implement direct measurements of a quantity, and complex MC that implement indirect, cumulative, or joint measurements, the initial part of which is divided into several simple MC.

The length of the MC can range from tens of meters to several hundred kilometers, and their number-from several tens to several thousand. Information from the sensors is usually transmitted by electrical signals (less often - pneumatic) - current, voltage, pulse repetition rate. In some measurement areas, modern sensors have a digital output. Radio signals are used for long MC distances. The secondary part of the MC, after the communication lines connecting it to the sensors, is usually called the measurement and computing (MCC), (complex component of the measuring system (complex component of the MC, measuring and computing complex): A structurally integrated or geographically localized set of components that make up part of the MC, usually completing measurement transformations, computational and logical operations provided for by the measurement process and algorithms for processing measurement results for other purposes, as well as generating output signals of the system.), or software and hardware (SHC) complex. A significant part of modern MCC (SHC) is built on the basis of controllers, usually of modular design, including analog-to-digital and digital-to-analog converters, a processor, discrete (binary) information modules (input and output), auxiliary devices [2].

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Kolesnikova D., Lukashevich K.

IT as a Driver of the Belarusian Economy

Belarusian National Technical University
Minsk, Belarus

Information is now becoming one of the most important resources of an organization. Regardless of the industry, the form of ownership and the specifics of the work, information technology, whether it be software products, operating systems, devices or technologies, are becoming the primary, basic need for the functioning of almost any organization in a modern market economy. According to the definition adopted by UNESCO, information technology (IT) is a complex of interrelated scientific, technological, engineering disciplines that study methods of efficiently organizing the work of people involved in processing and storing information; computing technology and methods of organizing and interacting with people and production equipment, their practical applications, as well as related social, economic and cultural problems. The economy of the 21st century – it is not an economy of goods and services, the more the economy is not factory chimneys, and the economy of knowledge and values, which are then transformed into products or services. Now the world is at the borderline when the entire world economy is changing and we need to become a part of these global transformation processes. The IT sector is the brain, circulatory and nervous systems of the economy. The Internet is a global transport artery for the dissemination of information, the development of electronic services and digital money, a link between many industries and the economy as a whole.

The Internet is the infrastructure for the development of new services and products. Information technologies are used in medicine and art, science and education, government and business, industry and trade. Further development of the financial sector and the economy as a whole is impossible without IT. The information and communication technologies (ICT) sector has become a driver of the Belarusian economy. This industry in 2019 makes the main contribution to the GDP growth of Belarus [1].

Explosive growth of computer services

The ICT sector employs only about 70 thousand people, but, despite the small number, it was this sector that began to determine this year the dynamics of the key economic indicator – gross domestic product. In January-August, GDP growth amounted to 1.1%. At the same time, the contribution of various types of economic activity to this growth clearly shows who exactly is the driver of the Belarusian economy today. So, for 8 months of this year, organizations that work in the "information and communications" sector ensured a GDP growth of 0.5%. The same contribution to GDP growth was made by other types of economic activity, but taken together (!) – industry, construction, agriculture, forestry, fisheries and trade (Figure 1). And this despite the fact that in the organizations that provide information and communication services, only about 70 thousand people work, and in other sectors of the economy - millions. International studies confirm that the contribution of the information and communication services industry to the Belarusian economy is growing. At the same time, a fresh UNCTAD report says that Belarus is ahead of other developing countries in terms of growth in the contribution of the ICT sector to GDP [2].

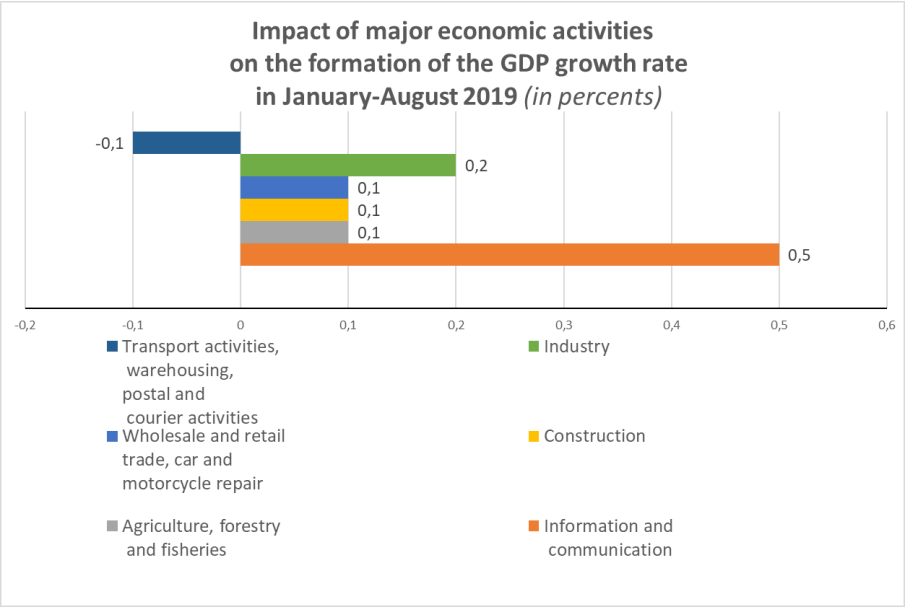

Figure 1 – Impact of major economic activities in January – August 2019

The core of the Belarusian information and communication services sector is the High Technology Park (HTP). According to official statistics, the average number of employees of the park residents in the first half of the year amounted to 47.5 thousand people and increased compared to the same period last year by almost 10 thousand employees.

As of July 1, 2019, 563 organizations were registered as HTP residents. Compared to the same date of the previous year, the number of residents of the park has increased by 272 organizations, or almost doubled. Today there are already 684 of them. But it is not even this that is impressive, but the high growth rates of export earnings of the residents of the Park of High Technologies.

In the first half of the year, the export of services by HTP residents amounted to $ 908.1 million and increased by 38.1%. The basis of HTP exports is computer services. Their exports in the first half of the year increased compared to January-June 2018 by 31.7% to $ 843.8 million. In the first half of the year, HTP residents received another $ 36.2 million in the form of payments to non-residents for the use of intellectual property, which is 2.5 times more than in January-June last year. We all can observe the formation of a market niche for the products of the "economy of the 21st century", with the dominance of intellectual industries, the implementation of constant innovative progress, as well as continuous improvement in the professional knowledge and skills of employees in most professions. Products and solutions in the field of "big data", mobile applications, cloud technologies and business intelligence are becoming drivers of growth. The priorities of the companies were mobility, quick business adaptation to market volatility, accuracy and efficiency of decisions, and cost reduction [3].

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Kulinich I., Lukashevich K.

Transformer Substations

Belarusian National Technical University
Minsk, Belarus

An electrical transformer is a device used to change the magnitude of an alternating current voltage at the same frequency, as well as for galvanic isolation of devices. The transformer consists of a core (metal frame, soprano made of many plates) and two insulated windings wound around it. When an alternating current is applied to one of the windings, a magnetic field is generated, which causes an alternating voltage to appear on the secondary winding. Often part of the secondary winding is part of the primary or vice versa. This type of transformer is called autotransformer [1].

Power transformers are widely used in the field of power

supply, which are part of transformer substations. A transformer substation is a multifunctional installation consisting of switchgears, a transformer, complete units and other auxiliary equipment, which performs the role of converting voltage from 10 kV and further transferring 380 volts to household networks [2]. Substations 10 for 0.4 kV

carry out the last stage of electricity conversion: from these substations, electricity goes directly to the consumer - to settlements and industrial enterprises. Let's consider the most common:

Mast substations are the most common in the power supply of individual settlements, small industrial facilities and other consumers in areas with a temperate climate from - 45 °

C to + 40 ° C. They have a wide range of models for capacities from 25 kVA to 100 kVA [1]. It gained its popularity for its compact design, high efficiency and the uselessness of installing an additional fence to protect against unauthorized access to conductive elements.

Pole substations are optimal for power supply of small

settlements, agricultural consumers, garden cooperatives, oil and gas fields, industrial facilities located in regions with a temperate climate. Equipped with additional equipment for street lighting control. The power of the power transformer is from 25 kVA to 63 kVA. This type of substation is not used in places of high vibration load and at explosive objects [3].

Kiosk substations are used to supply power to small settlements, railways and oil and gas fields. Kiosk substations, unlike others, are mobile. To install them, you only need a solid platform, protected from water penetration. The power of the variety of these substations is from 63 to VA to 1000 kVA [4].

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Lagunov D., Borodzionak I., Kozlovskaya D., Lukashevich K.
The Main Problems of Energy

Belarusian National Technical University
Minsk, Belarus

In our time, the three largest pollutants of atmospheric air and the environment in general include energy.
The energy problem is one of the most important problems that humanity needs to solve today. Due to the achievements of science and technology, such as instant communication, rapid transport, space exploration, which require huge energy costs, increased the growth of energy production and consumption, which subsequently put forward a new problem of environmental pollution, which is a serious danger to all mankind. Enterprises that generate energy, as well as various energy consumers, one of their results is a negative impact on the environment. The negative impact on the biosphere is manifested at all stages of energy production, for example: in the extraction and transportation of resources, in the production of enterprises, transmission and consumption of energy [1].

For example, when mining coal, the landscape changes, this is due to the formation of mines, quarries, dumps; when transporting coal – as a result of losses, dispersion of solid particles into the soil and into the atmosphere. When burning organic fuel, the following hazardous substances are formed: oxides of carbon, sulfur, nitrogen; soot, lead compounds, hydrocarbons, and other substances in the solid, liquid, and gaseous states. As a result of the transmission of electricity, powerful electromagnetic fields are formed near the power lines. The operation of power plants is inevitably associated with the loss of thermal energy.

Enterprises of the heat and power industry occupy one of the leading places in terms of emissions of harmful substances into the atmosphere. And this is not a joke, almost 30% of the total number of emissions of enterprises in all industries! As a result of such a process as air pollution of thermal power plants with sulfur dioxide, acidification of the soil by acid rain occurs. The accumulation of a large amount of carbon monoxide (carbon dioxide) in the atmosphere leads to a gradual increase in the average air temperature on the planet and its average annual indicators, such a phenomenon is called the greenhouse effect. Due to the poor ecology of the CHPP, aerosol chemically harmful particles, as well as organic dust, accumulate in the lower layers of the atmosphere. "Photochemical fog" is the name given to this phenomenon. If the necessary measures are not taken, this will lead to the destruction of the Earth's ozone layer.

Due to the rapid development of industry, the main amount of all gas emissions is concentrated in the Northern Hemisphere of the Earth. Most of the combustion products of all types of organic fuels are emitted on an area of only 3% of the planet's surface, namely in Europe, Japan and North America. Of all the gaseous substances, carbon dioxide and carbon monoxide are emitted in the largest quantities, which are formed during the combustion of natural fuels. Some of the most toxic compounds released into the atmosphere are sulfur dioxide and nitrogen oxides [2].

During the construction and operation of oil trunk pipelines, the main polluting components are oil and its vapors, waste water and combustion products. In the course of oil production by enterprises, the main pollutants are hydrocarbons, carbon monoxide and solids. The most effective solution to the problem of processing associated gas is its use in small-sized gas-generating power plants, which will meet the needs of enterprises in electricity and reduce GHG

emissions. To ensure the improvement of the environmental situation in oil production and refining, it is necessary to repair and replace outdated equipment of oil-producing enterprises, inside pipelines, using pipes with an increased anti-corrosion coating. Now the pollution of the atmosphere has serious consequences for humanity. This creates a threat to human health and the normal functioning of ecosystems. It is necessary to search for the weakest links in the ecosystem, to find the data of indicators corresponding to the most powerful factors, as well as the sources of their impact. All these measures are part of the environmental monitoring system - a unified system of methods and means of continuous monitoring of the state of the environment and a system for predicting the results of anthropogenic impact on it [3].

Here are some ways to solve the problems of modern energy. In the near future, thermal energy will remain dominant in the energy balance of the world and some countries. However, there is a high probability of increasing the share of coal mining and other less clean fuels in energy production. Let's look at some ways and methods of using them to significantly reduce the negative impact on the environment. These methods are based mainly on the improvement of fuel preparation technologies and the disposal of harmful waste. These include the following:

1. Use and improvement of cleaning devices.

2. Improving the insulation properties of buildings (in order to preserve heat).

3. Improving the efficiency of energy use [4].

Conclusion

The current level of knowledge of scientists, as well as the technologies available and currently under development, give grounds for encouraging forecasts, for example: humanity in the future is not threatened with a deadlock either in the complete exhaustion of energy resources, or in terms of

environmental problems generated by energy. After all, there are real opportunities for switching to alternative energy sources. In this case, the position of modern methods of energy production can be considered as a kind of transition to a new level. The main question is how long this transition period will take and what opportunities exist to reduce it.

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Mezhen E., Gerasimovich A., Alexandrova A.,
Lukashevich K.

Wind Energy Efficiency in Belarus

Belarusian National Technical University
Minsk, Belarus

It is a well-known fact that sooner or later, people will face a shortage of raw carbon materials: reserves of gas, coal and oil will be exhausted. Taking in consideration current volume of coal production, it will last for 400-500 years; and oil and gas – for almost a century. This is the reason why the analysis of the efficient usage of renewable energy sources is carried out all over the world. Scientists and governments of various countries, including Belarus, are working on the development of renewable, also called non-traditional, energy sources. For example, one of the inexhaustible sources is wind energy. Therefore, in the last two decades, interest in the use of wind energy has begun to grow [1].

Only 15% of our country's needs are covered by its own fuel and energy resources. The remaining 85% is imported (mainly from Russia). At the same time, in recent years there has been a constant increase in prices for imported electricity and fuel. This growth will only continue in the future, eventually reaching a very high level.

According to calculations, a wind turbine with a capacity of 1 MW can replace approximately 29 thousand tons of coal for 20 years. Using that type of energy will also lower the amount of carbon dioxide and other substances released in the atmosphere. Therefore, it is necessary to develop wind power industry of our country, and Belarus should master the production of its own wind power equipment based on modern technologies. Our

country independence should start with us developing local energy sources and preferably renewable ones. On average, Belarus energy sector may become fully independent by 2050 [2]. If we look at the national program of local and renewable sources development for years 2011-2015, we will see that 1,840 sites have been identified as those that can potentially accommodate single wind turbines and wind farms. The identified sites are mainly hills that are 20 to 80 meters high, with a background wind speed of 5 meters per second or more. In a spot like that, we can build 5 to 20 wind turbines.

At the moment, there are 23 wind turbines operating on the territory of our republic. They are installed in Minsk, Grodno, Mogilev and Vitebsk regions. The largest wind power plant in Belarus operates in the village of Grabniki, Novogrudok district, Grodno region, its capacity is 1.5 MW. That windmill is still the most powerful and largest one in Belarus. It is also the only one owned by the state. According to experts, the wind turbines will pay off within 5 years at an average annual speed of 6-8 m/s [3].

1) The average annual background wind speed at an altitude of ten meters

2) The average annual estimated wind speed at an altitude of one hundred meters (taking into account the data of monitoring wind parameters)

3) Map-diagram of the wind energy potential on the territory of Belarus at the height of the wind turbine installation one hundred meters from the ground surface (for wind turbines with an installed capacity of 2.5 MW) [4].

According to the forecasts provided by power engineers, Belarus can cover up to 50% of its energy needs by using only 10% of the territory suitable for wind energy purposes.

One of the reasons for the skeptical attitude towards wind energy is that it is not cheap. Here is an approximate cost of a serial wind turbine with different capacities:

- 6 kW is 7.2 thousand USD

- 60 kW is 60 thousand USD

Marketing research conducted by the specialists of the International Academy of Ecology showed that the payback period of wind power equipment is comparable to the payback period of small hydroelectric power plants, combined-cycle and gas-fuel power plants. However, it is significantly lower than the payback period of coal, nuclear and diesel power plants. At the same time, the cost of operating wind turbines is lower than the cost of operating power plants running on gaseous, liquid, solid or nuclear fuel. The large-scale development of Belarusian wind power industry will require appropriate marketing research, installation, construction work and creating a unique service sector. This will lead to creation of new jobs, more or less evenly distributed across the country. Overall, wind energy sector, like everything new, will require considerable effort and costs. And, of course, the activities of enthusiasts alone are not enough here. There is also a need for adequate and wise action by public authorities.

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Sushko I., Shevchenko D., Lukashevich K.

Thermonuclear Energy

Belarusian National Technical University
Minsk, Belarus

Humanity, in the process of its development, strives to improve the quality of its life. In order to achieve it, various gadgets and devices that simplify life were invented and created, such as smartphones, televisions, various smart appliances from vacuum cleaners to smart sockets. All these devices perform completely different functions, but they have something in common: they need energy to work. A hundred years ago, people only burned coal to produce electricity and were happy with everything, but now everything has changed. In the last few decades, people have been looking for new, alternative sources of energy because their needs have increased, their resources have decreased, and their environmental conditions have deteriorated. As a result of long research and development, many ways of generating energy have been invented and tested, such as solar energy, wind energy, water energy, geothermal energy, and so on. But one of the most promising, in my opinion, developments is the energy of thermonuclear fusion. Theoretically, a thermonuclear power plant can have high power, be environmentally friendly, and most importantly, the fuel for its operation is available in almost unlimited quantities [1].

Thermonuclear energy is a possible alternative to nuclear energy. Research in this area has been conducted since the 50s of the last century. In the process of thermonuclear fusion, the processes occurring inside stars, such as our sun, are reproduced. There is a connection of two atomic nuclei,

accompanied by the release of energy. For energy production, the reaction of deuterium and tritium synthesis is best suited. As a result of international cooperation, the development of an international project for an experimental thermonuclear reactor began in the mid-80s. In 2006, the preparation and construction of the site in the south of France began, and in the summer of 2020, the full construction of the installation began. It is planned to launch the reactor in 2025. The goal of the project is to prove the possibility of using a thermonuclear reaction to generate energy. The successful launch of the reactor will open up a new industry in the energy sector. Currently, scientists are actively researching and developing two types of thermonuclear reactors: magnetic plasma confinement reactors and inertial plasma confinement reactors. In order for thermonuclear reactions to self-sustain and produce useful energy, the product of nr must be greater than Lawson's criterion, at a temperature of 10.0 keV (about 10^8K). Thus, the goal of thermonuclear research and development is to achieve a value of n, t, T about $2 - 10^{24}$s*eV/m^3. Thermonuclear devices called tokamaks are currently the closest to achieving these conditions. Proposed in the early 1950s by Soviet physicists A.D. Sakharov and I. E. Tamm, this installation got its name from the abbreviation of the words "Toroidal chamber with a magnetic Coil". The principles underlying the operation of this device are relatively simple. First, the plasma is produced in a vacuum chamber shaped like a torus or a doughnut. A system of electromagnets located outside the chamber creates a toroidal magnetic field directed along the axis of the torus. The field acts as a hose that maintains the pressure inside the plasma and prevents it from contacting the chamber walls. Another system of electromagnets located in the center of the torus induces an electric current in the plasma, which flows in the toroidal direction. This current heats the plasma to a temperature of about 1 keV. The plasma current

creates its own magnetic field covering the toroid. This field prevents the plasma particles from drifting outside the main magnetic confinement region. Finally, the external conductc generate a vertical magnetic field that keeps the plasma cor from moving up and down, left and right inside the cha..ber [2].

Inertial plasma confinement and, accordingly, inertial fusion (ITS) was proposed in the USSR in the mid—60s of the last century. This direction, which is largely an alternative to the first one, is focused on creating such conditions (density) that the main part of the thermonuclear fuel "burns" before it explodes, without spending any effort on holding the plasma clots. At the same time, the difficulties that in the tokamak consist in holding the plasma were transformed into the task of heating it in a very short time. The time and parameters of this process are determined by the inertia of the fuel mixture, so heating should be carried out in a time of about 10^{-9} s. Currently, the creation of pulsed reactors is at the stage of physical research and justification of conceptual projects [3].

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Edalo E., Gruzd N., Lukashevich K.
The Ultimate Question of Muscles, Bionics and Everything

Belarusian National Technical University
Minsk, Belarus

Imagine the first prototypes of mobile phones and then pay attention to what advanced devices exist nowadays. This is how recent artificial limbs look in comparison with their potential designs. It is quite obvious that prosthetic medicine needs fresh ideas and hopefully the progress does not stand still.

Figure 1. The bionic prosthesis

Bionics is a word from biology and technology. Bionics can be characterized as an attempt of developing technical solutions on the example of nature. The bionic prosthesis works by reading the electric potential generated by the tension

of the remaining muscle tissues of the arm with special myo-sensors [1] (Figure 1).

The myo-sensors, which ensure the correct reading of the electrical potential, consist of sensing electrodes. They transmit the readout signal to the microprocessor, which processes the information received using computer algorithms. The microprocessor generates commands and sends them to the motors, which drive the active parts of the prosthesis.

Multi-pivot arm prostheses, which now perform a wide variety of gripping patterns and individual finger movements, require simultaneous or multimodal control. Coded synergies are stored in the CNS, which can be called up and combined for specific tasks so that the corresponding contraction models fulfill the kinematic task of the hand. It requires an initial learning phase in which the classifier uses machine learning algorithms to correlate various positions and movements of the prosthesis with myoelectric activation patterns [2].

However, intuitive operation using pattern recognition algorithms becomes impossible in cases, when necessary muscles are lost. The Targeted Muscle Reinnervation method is now an important step forward: with a surgical procedure, the motor neurons of the lost muscles are transferred to the remaining muscles. These muscles generate action potentials as a result of motor commands from the transmitted neurons and thus function as their amplifiers for receiving EMG signals.

Although artificial limb sometimes can even surpass the functionality it’s still perceived as something unfamiliar. It is believed there are to key factors, that prevent robotic part wholly replace the lost limb: the limited motion and lack of sensibility.

The most advanced and functional prototypes of prostheses are still based on servomotors. Servos are cheap and easy to work with however they are not able to imitate motions of human body clearly. That is why the idea of synthesizing

artificial muscles seems to be one of the most perspective branch of prosthetics.

Artificial muscle fibers are needed for diverse applications, ranging from humanoid robots to comfort-adjusting clothing and miniature actuators. Recent advances in nanomaterial fabrication and characterization, specifically carbon nanotubes and nanowires have had major contributions in the development of the sphere. Recently developed muscles include highly oriented semicrystalline polymer fibers, nanocomposite actuators, twisted nanofiber yarns, oil-driven actuators, thermally activated shape memory alloys, ionic polymer and metal composites, dielectric elastomer actuators, conducting polymers, stimuli responsive gels, piezoelectric, electrostrictive, magnetostrictive actuators and even origami-inspired prototypes (Figure 2).

Figure 2. Fluid-driven origami-inspired artificial muscle

However, performance, scalability and cost problems make modern designs inappropriate to use in medicine.

In its minimal form, an artificial somatosensory system consists of three components: a tactile sensor, an interface system, and a stimulator. For many years, engineers at the University of Glasgow have been developing "electronic skin" for hand prostheses that is sensitive to touch without being too expensive to manufacture. The skin presented had the ability to sense pressure, temperature, and texture through an array of neural sensors.

The age of so-called cyborgs shown in fictional stories is rapidly coming. Soon the progress will bring us to the point when exchanging the part of the human body has become as usual as tooth filling.

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Isengaliev D., Arashkevich E., Kozhemyako M., Lukashevich K.

Nuclear Power Plant Safety Systems

Belarusian National Technical University
Minsk, Belarus

The basis of safety systems is the reliable retention of radioactive substances within the specified boundaries of nuclear power plants. The safety system includes five barriers: the fuel element shell, biological protection, the crystal lattice of fuel pellets, the border of the first circuit, and the hermetic shell. The fuel rod shell is made of zirconium alloys, practically devoid of impurities, with a small addition of niobium. Under normal operating conditions, all fission products remain inside the fuel element [1]. Biological protection is mainly represented by a screen or a system of screens made of protective materials (lead, steel, water, concrete). It is installed between the source of radioactive radiation and the area where people are located. The tablets are sintered at a temperature of 1650 °C before being assembled into a fuel cell, acquiring ceramic properties and retaining some nuclides [1]. The first circuit is designed to transfer heat from the active part of the reactor to the water of the second circuit to form steam. The water of the primary circuit is composed of boric acid, to slow down the reaction in the core. The water of the first and second circuits does not mix. Hermetic shell (container)-this is a thick layer of concrete that protects the environment from radiation. Inside the concrete layer, metal cables are stretched, which give the structure additional solidity and increase its stability. The container is designed and constructed in such a way as to withstand the

internal and external impact of a huge force. The powerful dome of the hermetic shell is so tightly pressed to the body that the reactor is not afraid of: a shock wave that creates a pressure of 30 kPa; a plane weighing 20 tons falling at a speed of 200 m/s (720 km / h); a hurricane and a tornado with a wind speed of up to 56 m/ s; a flood; earthquake up to 8 points. Each of these barriers ensures the safe operation of the reactor from both external influences and internal failures in the reactor control systems. On the example of the VVER-1000 nuclear reactor, the following safety systems are used, which include systems for emergency cooling of the high and low pressure core (SAOZ), systems for protecting the first and second circuits from excess pressure, systems for emergency gas removal and emergency feed water supply. In order to prevent a break in the cooling of the core, the SAOZ has a system called the passive part of the SAOZ-a system of hydraulic accumulators, designed to quickly supply a solution of boric acid. If the cooling systems fail, the molten core will start to drain into a special concrete cup called a melt trap. It contains steel sacrificial material and oxide sacrificial material(Fe_2O_3, Al_2O_3), which reduces the formation of volatile materials, lowers the temperature, and crystallizes the melt [1].

The design of safety systems is associated with a high risk of emissions of radioactive substances into the atmosphere as a result of possible accidents, so at present, almost half of the total cost of construction of nuclear power plants is spent on equipment for safety systems of nuclear power plants.

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Rozum V., Truhanenko M., Lukashevich K.
Cryptocurrency

Belarusian National Technical University
Minsk, Belarus

In the year of 2017, the following words were popular - bitcoin, blockchain and others. After that, it was reported that the bitcoin exchange rate has fallen 6 times. In view of recent events, for a couple of months many people have been hearing about new records for the value of the so-called MMM heir. However, this is all fine, but what the above words mean will be difficult to understand, even if you spend enough time studying Wikipedia, so we decided to try and explain the work of the "bubble", but for this we need you to define some concepts.

To ensure that the idea of all the written above can be grasped, we will begin with such a term as *blockchain*. In essence, that is a chain of blocks with information, where each other block, in addition to its unique information, contains information about all previous blocks. This method of storing information well prevents from its changing. In other words, to change the information in one block, you need to rewrite all the previous blocks, and their number is practically unlimited. This is also a disadvantage, because it is impossible to change the information in the middle of the chain [1].

Also, it should be added that all bitcoin owners store blocks with information about all transactions ever made with this currency and are constantly adding new blocks to the end. That is, this same chain is the same for everyone and is stored completely. The next term to be introduced is *miners* are those people who always add new blocks with information about

transactions and previous blocks. As a reward for their calculations, the miner receives bitcoins. That is, literally, the first line of the new block, the miner writes – "deposit 12.5 bitcoins to my wallet". Bitcoins for the reward are taken from nowhere, that is, mining is also the only way to create new bitcoins.

Moreover, the reward for creating a new block is constantly decreasing, namely, one can mine a limited number of bitcoins (21 million), as of 2017, more than 15 million bitcoins have already been issued. A permanent reduction in remuneration exists as a measure of protection against depreciation. So, initially, the creation of a new block was rewarded with 50 bitcoins, after a couple of years - 25, and et cetera.

The problem with this reward is that an infinite number of people can participate in the creation of a new block, and only the one who encrypts the information about the previous blocks in the new block itself will receive the reward. The solution to this problem is *mining pools*, services that unite miners and distribute the reward among all participants, depending on their contribution to the writing of a new block.

There is also such a thing as the complexity of mining, it grows in direct proportion to the number of new miners involved in writing new blocks. This information is worth understanding – so what exactly do the miners do? We understood that according to the rules of the blockchain, each block, in addition to information about transactions made with bitcoin in its block, must contain encrypted information about all transactions in all previous blocks. So miners are engaged in encrypting this information into a hash sum. It is a set of numbers and symbols obtained by complex mathematical calculations which are called *hash functions.*

For this reason, as we said previously, the reward will be received only by the one who encrypted this information in the

most beautiful form (usually the criteria for the beauty of the hash amount are zeros in the beginning). That is, if today the number of miners increased 100 times, then the hash sum of the new block would be 100 times "more beautiful" than yesterday, that is what complexity is. It is noteworthy that this also works in the opposite direction, namely, if all but one person on earth stops mining, this does not mean that this poor guy will have to recalculate the hash amount for millions of years to achieve the necessary “beauty”, the complexity of mining will fall by as much as it is necessary for this person to calculate the hash amount.

Now, a little bit more about the equipment for bitcoin mining. Bitcoin is mined with the help of so – called *“asics”* - narrowly focused computers needed to perform a specific task, the power of asics is much higher than the power of any other equipment used for mining cryptocurrency. The main characteristic that reflects the efficiency of mining equipment is hash per second (h/s).

Now, as mentioned earlier, the complexity increases in direct proportion to the number of mining operations, but now it can be formulated more exactly – the complexity increases in direct proportion to the total capacity of the new equipment. In the case of bitcoin, the appearance of “asics” greatly increased the complexity and yesterday's equipment was ineffective, and the purchase of expensive “asics” was not affordable for cryptocurrency enthusiasts. In this regard, I would like to touch upon the topic of other cryptocurrencies.

The most popular cryptocurrency after bitcoin is Ethereum (ether / ethereum, $ 1,913.10 as of 02.22.2021 [2]) precisely because of this cryptocurrency, people with any knowledge of computers hate miners.

A feature of this and other so-called altcoins (altcoin is an alternative coin (everything that is not bitcoin)) is that expensive ASICs are not used for its production, since the

algorithms for extracting ether allow it to be mined on ordinary computer video cards. This fact is the reason for the hatred of ordinary people towards miners. If it suddenly occurs to you to assemble / buy a ready-made computer capable of running something more demanding than a sapper, you will have enormous difficulties.

Ordinary people around the world bought up almost all existing video cards, which led not only to a shortage of these very video cards, but to another reason for the shortage of semiconductors in the world as a whole. Let me remind you that semiconductors are used in absolutely all digital products - smartphones, televisions, even cars. Therefore, in the digital field, the opinion about miners is not the best.

Another feature of the ether architecture is the presence of a dag file loaded directly into the memory of the video card, the dag file is essentially a data block, more than 1 GB in size, used to find a block solution in the blockchain network based on the Dagger Hashimoto algorithm (ether mining algorithm). The size of the DAG file increases by 8MB over time. This happens every 30,000 blocks (which is equivalent to 10.4 days) and is called a change of epochs. Because of this feature, 2 GB video cards stopped working on the Ethereum network in November-December 2016. Video cards with 3 GB memory completed their journey in ether mining at the end of 2018, and just a month ago, video cards with 4 GB were not suitable for mining.

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Romanyuk A., Otchik Y., Sukhaver E., Lukashevich K.

The Importance of Standardization

Belarusian National Technical University
Minsk, Belarus

Standardization plays a very essential role as it affects all spheres of human life and ensures the efficiency of economic, financial and production processes.

The history of standardization began a long time ago. Even in ancient Egypt, bricks of the same size were used in construction; at the same time, special people were engaged in controlling the size of the bricks. In the Middle Ages, with the development of crafts, standardization methods were used more and more often. In 1891, in England, and then in other countries, the standard inch thread was introduced, later it was replaced by the metric thread. In 1870, standard sizes of bricks were established in European countries.

The units of measurement were set randomly: for example, the "elbow" corresponded to the length of the scepter of Henry I; the "foot" unit of length, widely used in many countries, corresponded to the length of the foot of Charlemagne. The search for more reasonable units of measurement began long ago. In 1790, in France, a unit of length "meter" was created, equal to the ten-millionth part of a quarter of the length of the earth's meridian. However, it took 85 years before the first 17 States that took part in the International Metric Convention in 1875 in Paris agreed to adopt the meter as the unit of measurement of length.

In 1901, the Standards Committee was established in England, whose main task was to promote the strengthening of the economy by developing and implementing standards

for raw materials, industrial products, and military equipment. With the development of monopoly capitalism, standardization began to develop on an international scale. The constant expansion of international trade and the need for closer cooperation in science and technology led to the founding of the International Association for Standardization. In 1946, the International Organization for Standardization was founded in London, which included 33 countries. Currently is one of the largest international technical organizations (its members are 91 countries) [1].

In Belarus, the Law "About technical regulation and standardization" which regulates relations arising from the development, the adoption and application of technical requirements for products and processes development, production, operation, and so one. The Document is aimed at providing a unified state policy in the field of technical regulation and standardization. Such documents include technical regulations, technical codes of established practice, standards and technical conditions, and other legal acts. According to the law, the standards are divided into state (national) and standards of organizations. As for state standards, they set product requirements, implementation rules, and characteristics of production processes and other life cycle stages of making products. In addition, they determine the methods of acceptance and control, compatibility, rules for ensuring product quality, and energy efficiency. The standards may also contain requirements for terminology, symbols, packaging, labeling or labels and the rules for their application, as well as any organizational rules. Thus, the range of standardization objects is quite wide. As a result, standards are a technical language in which specialists speak and understand each other.

In the Republic of Belarus, the following standards are being developed, the type of which depends on the specifics

of the object of standardization, as well as the content of the requirements established for it. They are fundamental principles, product standards, standards for processes and standards for control methods [2].

Summing up, standardization is a tool for ensuring the quality of products and services; a guarantee of profitable, legitimate and productive relationships between economic entities. Standardization is an opportunity to save time and material resources through the use of already developed standard situations, technologies and objects; to increase the reliability, survivability of the product or the results of calculations, since the applied technical solutions have already been repeatedly tested in practice; to simplify the provision of services to the population of the state, make them of high quality and give a guarantee of safety [3].

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Khramkova A., Kravchenko K., Lukashevich K.

Heart Transplantation

Belarusian National Technical University
Minsk, Belarus

Heart transplantation is an operation in which a diseased heart that can not cope with its functions is replaced with a healthy donor organ.

Although heart transplantation is a complex operation, the chances of survival in such patients are quite good, especially with careful and proper medical care, which is strictly observed in Belarus [1].

Who needs a heart transplant? Heart transplants are used to treat heart failure that is not amenable to other therapies. In adults, severe heart failure can result from:

- weakening of the heart muscle (cardiomyopathy);
- valvular heart disease;
- congenital heart defects;
- ischemic heart disease;
- unsuccessful previous heart transplant.

In children, heart failure is most often caused by birth defects or cardiomyopathy.

A lot of information is needed to determine if a patient is suitable for a heart transplant. The examination process is carried out by cardiac surgeons, cardiologists, anesthesiologists, psychologists and other specialists. Preparation of the patient, in addition to the standard preoperative examination, includes:

1) Assessment of the psychological state and social status;
2) Blood tests;

3) Instrumental examinations.

In Belarus, doctors performing heart transplants carefully study all information about the patient and his health condition in order to determine the possibility of an operation. After they recognize the patient as a candidate for transplant, they are included in the list of recipients waiting for a suitable donor organ (so-called waiting list).

How is a heart transplant carried out?

After a suitable donor appears, doctors surgically remove the heart from its body. It is cooled and stored in a special solution until the time of transplantation to the recipient. Before starting the operation itself, the cardiac surgeon must make sure that the donor heart is in good condition.

During the operation, the patient is transferred to artificial circulation. This allows the body to receive oxygen and nutrients from the blood. After that, surgeons remove the patient's own heart and replace it with a donor heart. Then they connect the blood vessels, allowing blood to circulate through the new heart and lungs. After warming, the heart begins to contract. Surgeons carefully check all blood vessels and their connections, then turn off the heart-lung machine, and then suture the wound.

For some patients with advanced heart failure, heart transplantation may not work. In addition, donated hearts are not always available, so it may be necessary to wait several years before a suitable heart is found. Mechanical circulatory support is a way to improve blood circulation throughout the body using a special heart pump called an artificial left ventricular assist device (VAD). ALV helps the damaged heart pump blood throughout the body. It does not replace the heart chamber, which will continue to function normally.

ALV are used for 3 main reasons:

1) They support the vital functions of patients until the moment of donor organ transplantation. In this case, ALV is used as a temporary solution while awaiting transplantation.

2) Allows the heart to "rest" so that it can restore a number of its functions. In patients who are showing improvement, the device can be removed, and transplantation may not be necessary at all. In such cases, VAD is used as a transitional stage to recovery.

3) Provides mechanical support for blood circulation for several years. This is usually an option for patients whose heart condition is too severe to survive a transplant. In this case, the ALV is implanted as the ultimate targeted therapy.

The design of most ALV devices includes 3 parts:

- a pump that is installed inside the body (implantable ventricular accessory) or outside (external or wearable device);
- the system controller, which is outside the body and is used to program the parameters of the device;
- an external power supply for the pump (it can be a console or batteries).

When and how is it applied?

The implantation of an ALV requires surgery under general anesthesia. A cardiac surgeon will connect the machine to the apex of the left ventricle and implant a cannula into the aorta to draw blood from the ventricle and re-enter the systemic circulation (artificial left ventricle) or pulmonary artery (artificial right ventricle). As a result, blood flow in the body increases and the perfusion of internal organs improves.

Living with an ALV will lead to some changes for you and your family. The battery management process is pretty straightforward. However, despite significant technological advances, a percutaneous cable (transmission) is still needed to connect the internal pump to the external controller. Moreover, the place of its exit requires special processing to prevent infection. Certain heart failure medications and anticoagulant

therapy must be continued. However, most people with VAD are able to live at home, move freely, enjoy their favorite activities, and even return to work or school. Many VAD patients also find they have more energy than before because more oxygenated blood is now circulating in their bodies.

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УДК 004.356.2

Voitiuk D., Kruglei N., Rossolovskii A., Lukashevich K.
3D Printer

Belarusian National Technical University
Minsk, Belarus

3D printing is a revolutionary technology that has recently caused a stir due to its ingenious concept used in its invention and its enormous potential to influence the current manufacturing process. An incomparable device that is used to create a 3D object from a digital file; 3D printers have created wonders in the digital printer world. The practice of creating a 3D object uses a chemical approach and additive processes in which an object is manufactured by arranging a series of coatings on top of each other until an intact object is formed.

What is a 3D printer? 3D printers are used to create 3D objects and objects by printing. This process is also called additive manufacturing [1].How Do 3D Printers Work? 3D printing is part of the additive manufacturing family and uses techniques similar to traditional inkjet printers, albeit in 3D. 3D Modeling Software. The first step in any 3D printing process is 3D modeling. With the ability of 3D modeling software to create precise designs, 3D printing is considered a true game changer in many industries [2]. This modeling software is especially important in an industry like dentistry, where laboratories use 3D software to design dental aligners that are precisely tailored to the individual. The 3D Printing Process. With the modeling and slicing of the 3D object completed, it is time for the 3D printer to finally take charge. In direct 3D printing, the printer generally acts like a traditional inkjet printer, with the nozzle moving back and forth, spreading layer by layer of wax or plastic-like polymer, waiting for that layer

to dry, and then adding the next layer. Basically, it adds hundreds or thousands of 2D prints on top of each other to create a 3D object. There are many different materials that a printer uses to recreate an object to the best of its ability. Here are some examples: Acrylonitrile butadiene styrene (ABS): a plastic that is easy to form and difficult to break. The same material that LEGOs are made of. Carbon fiber filaments: Carbon fiber is used to create objects that need to be strong yet extremely lightweight. Conductive filaments: These print materials are still in the experimental stage and can be used to print electrical circuits without the need for wires. This is a useful material for wearable devices. Flexible threads. Flexible filaments create flexible yet durable prints. Anything from wristwatches to phone cases can be printed with these materials. Metallic thread: Metallic threads are made from finely ground metals and polymer glue. They can be in steel, brass, bronze and copper to get the true look and feel of a metallic piece. Wood filament: These fibers contain finely ground wood powder mixed with polymer glue. They are obviously used for printing wood objects and can appear as lighter or darker woods depending on the temperature of the printer.

How to make a 3D printer with your own hands:

1. 2D design.

2. Design in 3D.

3. Part Creation - This is how all parts are created: Print a drawing of the part to be manufactured; Take a pencil, caliper, tape measure and something to draw the details; Draw a top view on the tree; Saw the part to the desired shape; Drill holes where necessary; Measure detail.

4. Purchased parts.

5. Assembling the Printer - Start assembling the frame with most of it at hand. 2 of the bottom threads were used to mount the Y-axis stepper motor. Another 2 were used to mount

the Y-axis belt bearings. Next comes the heated bed. A thermistor should be placed at the bottom of the heated bed to control the temperature. A 20cm x 20cm mirror or glass should be placed on top of the bed, which is used to create a smooth FLAT printable surface.

6. Power - The printer used 12v, a lot. You can use an old ATX power supply, cut off all 5V and 3.3V wires, link two buses (12V and 12V 1).

7. Printer Connection - The next task was to connect ALL wires to the correct pins.

8. Software - There are 2 main firmwares for Ramps. Merlin, Sprinter.

9. Setting up the steppers - To do this: Turn on your printer; Use "Printrun" to move the axis; Move one of the axes back and forth; Simultaneously move the potentiometer on the driver clockwise until the stepper motor starts to run abnormally (make strange noises, vibrate violently); Turn it back slightly until it starts running smoothly again; Move to next driver / step / axis.

10. Testing – The next step is to check the printer and its settings. Heating of parts. Stay with your printer. If something goes wrong, it is important that you can turn off the printer [3].

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Ivankov N., Vernitsky S., Panafidnikov E., Lukashevich K.
Information Measuring Technology

Belarusian National Technical University
Minsk, Belarus

History of IIT (SMD)

In 1979, the specialty «Semiconductor and microelectronic devices» was opened at the Belarusian Polytechnic Institute, and the department «Semiconductor micro - and Optoelectronics» was created for training in this specialty. Later, in 1982, a research laboratory of semiconductor technology was opened at this department. In 1990, the specialty «Semiconductor and microelectronic devices» was transferred to BSUIR. In order to preserve the scientific, personnel and material-technical progress, the specialty «Information and measurement technology» was opened at the BNTU, followed by the opening of the department of the same name. In the following years, the Department of Information and Measurement Technology acquired more and more new specialties, such as «Micro and nanotechnology», «Information and Measurement Technology», «Technical security», etc.

At the moment, the Department of IIT of the BNTU is one of the leading instrument-making departments of the Republic of Belarus, which trains specialists in the field of information and measurement technology and its applications in various areas of the national economy. The department trains specialists with higher education in a form integrated with secondary specialized education.

The department has the closest contacts with enterprises and organizations interested in graduates of this

specialty. Among such enterprises are PA «integral», JSC plant «SpetsAvtomatika» and others. On the basis of these enterprises, it is possible to conduct practical training, which allows you to deepen the knowledge of students in the field of study, as well as give a real idea of the future profession.

In the modern view, information and measurement technology is the most versatile and popular engineering specialty of the 21st century. The continuous increase in the role of information technology has led to the widespread automation of not only measurements, but also the automation of a large number of production processes, an increase in the number of sensor technology. At the moment, modern technologies have confidently settled in our lives, which in turn has led to a sharp increase in the need for specialists in the field of information and measurement technology. At the moment, training in this specialty is possible in two universities of the country: «The Belarusian National Technical University» and « Yanka Kupala State University of Grodno» [1].

Scope of application

The scope of application of specialists in this specialty is:

1. Design of measuring instruments and information and measurement systems.

2. Development of software for information and measurement systems.

3. Installation, adjustment and maintenance of technical means of information and measuring equipment.

4. Development of normative and technical documentation for measuring instruments.

5. Metrological support of measuring instruments and information and measurement systems.

6. Development of technological documentation, participation in the creation of standards and regulations.

7. Perform operational control over the operation of devices and systems of information and measuring equipment.

Graduates of the specialty «Information and measurement technology» acquire the professional qualification of a specialist «Electronics engineer» and work in various fields related to the receipt, processing, storage and protection of measurement information. For example:

1. In the industry, as engineers-developers of measuring information systems and devices;

2. In modern enterprises, as engineers and managers for the development and implementation of innovative projects;

3. In small enterprises for the development of small microprocessor-based measuring devices and systems that are in high demand among consumers and are widely used in industry.

The specialist «electronics engineer» assumes the presence of professional competencies in the following areas:

1. Knowledge and skills in the field of measurement of electric, magnetic and non-electric quantities with the use of devices, systems and complexes of information and measuring equipment;

2. Design of devices, systems and complexes of information and measuring equipment;

3. Commissioning, testing, repair and maintenance of devices, systems and complexes of information and measuring equipment;

4. Development and implementation of new methods and means of measuring electric, magnetic and non-electric quantities, etc.[1].

Demand in the modern labor market

Due to the increase in the number of complex equipment in our lives, the role of information and

measurement technology specialists in the labor market is also increasing.

Today, these specialists will be in demand in almost all areas of modern life, from small private enterprises to large state-owned enterprises, including international-class enterprises.

Job prospects

Graduates of the department work in Belarus and abroad in high-tech sectors of the economy: electricity and heat power, oil and gas industry, aviation and space industries, mechanical engineering, research centers, instrument making, medicine, food industry.

In addition, graduates participate in the development of data collection and processing systems for complex technical objects (hydroelectric power plants, thermal power plants, shipping locks) in design organizations.

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Gushcha S., Mileiko A.

Comparative Analysis of Education Systems of the UK and the Republic of Belarus

Belarusian National Technical University
Minsk, Belarus

Education is a process of education and training of people for the benefit of society, the individual and the state, which sets and levels of education. What are the differences of education systems in Belarus and the UK? Compare the two systems.

The academic year in England is different from the Belarusian. English students have more holidays during the year.

Academic year in schools of Belarus is divided into 4 terms, at the end of each of them exhibited an overall assessment for each study subject. At the end of the year is really on the subjects, derived from the mean values of estimates for the quarter. The school year starts on the 1st of September and ends in late May, typically, on the 31st of May. Each lesson lasts 45 minutes. Belarusian students have breaks each lesson. It lasts 10-20 minutes. The school examinations are taken after the 9th and after the 11th grade. Also there are entrance exams and interviews for admission to school.

In the education system of Belarus there are two official languages: Russian and Belarusian. In contrast to our country in England there are paid and free school, and boarding schools (where children live and learn). Parents can choose where to send their child [1].

The system of organization of lessons in England is slightly different than in Belarusian schools. The academic

year is divided into three terms, each lasts about 13 weeks. In England, the first four lessons are generally without rest. When they have dinner, they have a rest about 50 minutes. The school day usually begins at 9am. The lesson can last 60 minutes or more. In Belarus and in the UK 11-year school education is compulsory for children aged 5-6 to 16-17 years. Compulsory education consists of two stages: primary and secondary education, called Primary and Secondary Education. Belarusian Certificate of secondary education is the analogue of the British certificate of complete secondary education GSCE [2].

The higher education system in Belarus is the creation of two-tier higher education system. The number of specialties suggests an additional period of externship for six months at the end of the five-year period of study: six years and more for students of medical universities, as well as part-time students. Students enroll for a particular course according to the results of CT. Educational program of each course is determined by the state educational standard of higher professional education. In most universities the academic year consists of two semesters – spring and fall sessions, winter and summer practices, summer and winter vacations.

Most University courses last from two to four years. Courses with a break for practice can extend this period for another year, and medical and veterinary courses last five years. This is a basic course after which students receive a bachelor's degree. They continue the course for another year (on philosophical specialties two) to get a master's degree. The academic year at English universities is divided into three terms: October to mid-December; from mid-January to late March; mid-April until the end of June or to early July. Exams are held after the end of each term, and there is main exam after each course [3].

If Belarus to higher education is not only a fee but is free in England only for a fee basis. However, if the Belarusian

students must deposit money during the learning process, in England one could pay only after graduation and employment at minimum wages in the amount of 21 thousand pounds a year. Study "in debt" gives the possibility of obtaining higher education to the poor of Great Britain.

Belarusian students to enter British universities directly after high school may not: equivalent to secondary education in the UK is considered the Belarusian certificate secondary education and two years of study in any University. More common than in England in Belarus have received such form of training, as absentee and evening. In Belarus higher education primarily involves the acquisition of a specialty, and in England, getting an advanced or doctoral degree. As for the technical professions, as they say Belarusian students studying at British universities, the learning process is no different from our own: the same control, course, exams. But in Britain, the material and technical base is large, much more than the Belarusian.

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Taranko E., Mileiko A.

Nuclear Waste Disposal

Belarusian National Technical University
Minsk, Belarus

Nuclear energy is one of the most controversial energy sources we have. For some people, the potential risk associated with nuclear power is too high. For others, nuclear looks like the answer for a zero-carbon future with high energy density. Unlike solar and wind energy, which need the sun to be shining or the wind to be blowing, nuclear power can be generated at any time throughout the day. This means that a nuclear power plant can produce energy nonstop, and you won't have to experience any delays in energy production. With a carbon-free future in mind, entrepreneurs and startups are leading the way toward the next generation of nuclear. Nuclear energy is formed by splitting uranium or plutonium atoms through chain reactions in a nuclear reactor by a process called 'nuclear fission'. The energy released from splitting the atoms is used to heat water into steam. This steam then turns a turbine, which creates usable electricity.

The main problem of nuclear energy is radioactive waste generated in the process. I am going to look into the ways of disposing of nuclear waste to get full advantage of this type of energy.

Radioactive waste includes any material that is either intrinsically radioactive, or has been contaminated by radioactivity, and that is deemed to have no further use. Government policy dictates whether certain materials – such as used nuclear fuel and plutonium – are categorized as waste. Every radionuclide has a half-life – the time taken for half of

its atoms to decay, and thus for it to lose half of its radioactivity. Radionuclides with long half-lives tend to be alpha and beta emitters – making their handling easier – while those with short half-lives tend to emit the more penetrating gamma rays. Eventually all radioactive waste decays into non-radioactive elements. The more radioactive an isotope is, the faster it decays [1].

Radioactive waste is typically classified as either low-level (LLW), intermediate-level (ILW), or high-level (HLW), dependent, primarily, on its level of radioactivity.

Talking about low level waste, waste management is separated in 3 types: Low level Waste which has a much shorter radioactivity life than the others. Second is intermediate level waste which has been exposed to alpha radiation, or contains long-lived radionuclides, it constitutes 33% of the waste. This type of waste needs shielding and containment for period over 100 years. Finally, the most dangerous type is high level waste responsible for 36% of the waste, it results from burning uranium fuel. High Level Waste is composed from used fuel that has been designated as waste, and separated waste from reprocessing of used fuel (Figure 1) [2].

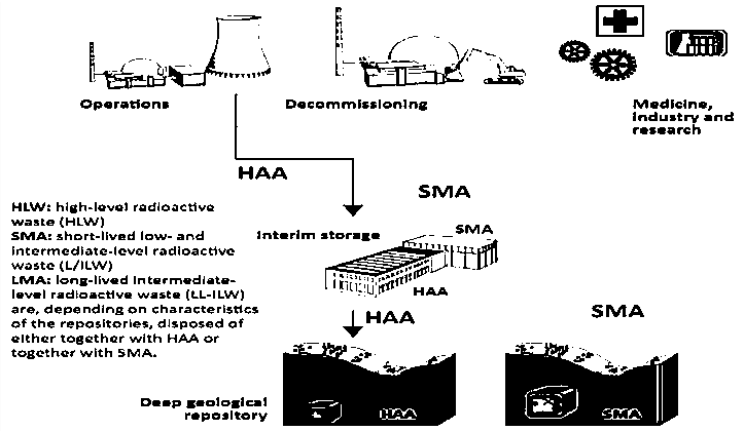

Figure 1 – Treatment of nuclear waste

Treatment involves operations intended to change waste streams' characteristics to improve safety or economy. Treatment techniques may involve compaction to reduce volume, filtration or ion exchange to remove radionuclide content, or precipitation to induce changes in composition.

It is important to note that, while treatment processes such as compaction and incineration reduce the volume of waste, the amount of radioactivity remains the same. As such, the radioactivity of the waste will become more concentrated as the volume is reduced. The combustible elements of both radioactive and other wastes can be incinerated to reduce volume.

Currently, there are three options widely used to store nuclear waste. First option is to store it in temporary pools or dry casks, the method is the following, after the fuel is being used it's placed in water pools for ten years to decrease its radioactivity, then it's contained in dry storage containers for a 50-year period. Second option is to bury the waste deep underground for hundreds of thousands of years, it's called "deep geological repository". This is the safest way for the environment and humans. The third option is to reprocess spent fuel for re-use, it can separate out usable uranium and plutonium. Reprocessing sounds like the best solution as it's recycling the nuclear waste; however, that's not the case because this method is very risky for the global stability [3].

It's a societal problem that has been handed down to us from our parents' generation. And we are – more or less – handing it to our children. Regardless of whether you are for or against nuclear power, and no matter what you think of nuclear weapons, the radioactive waste is already here, and we have to deal with it.

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УДК 656.07

Shurman E., Pinchuk I.

Development of International Multimodal Transportation

Belarusian National Technical University
Minsk, Belarus

The participation of Belarus in the implementation of the «One Belt and One Road» project (the Silk Road Economic Belt and the Maritime Silk Road of the XXI century) contributes to the development of relations between Belarus and China. The initiative was launched by China in 2013 with the aim of building a trade and logistics infrastructure connecting Asia with Europe and Africa. The Republic of Belarus, despite its small scale, is an active participant in the implementation of this global investment project [1].

Multimodal transportation is the transportation of goods that is carried out by different modes of transport, but within the framework of a single contract. The type of transport does not matter – it can be rail, water, road, and so on. Multimodal international transport is used in such cases: there is no direct single mode of transport communication between the sender and the recipient of the cargo; direct single mode of transport communication is not suitable for the consignee due to the high price or long delivery time [2].

Intermodal transportation is the transportation that is carried out by different modes of transport, and the customer may involve several companies for transportation (Figure 1, 2). The type of transport in the case of intermodal transport can also be any, and the responsibility is evenly distributed among all participants.

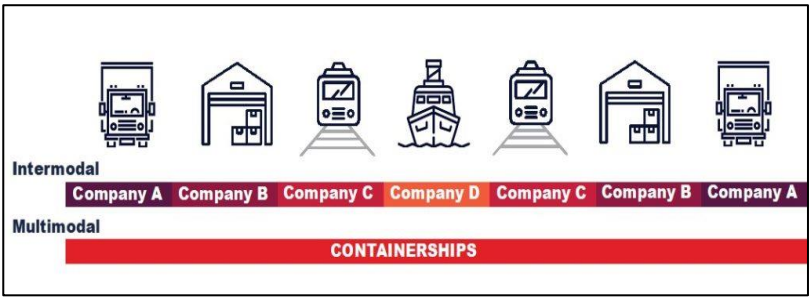

Figure 1 – Intermodal Transportation

The advantages of multimodal transport are reflected in their features. The most significant advantages are:

1. It can be used when there is no direct single-mode communication between the shipper and the recipient.

2. Reduction of risks and costs due to the fact that the customer places an order in one company. The client does not have to fill out a large number of documents. This allows you to save time and effort, solve the issue as quickly and efficiently as possible.

3. Reduced waiting time for cargo. The logistics company will independently involve reliable, proven contractors in the execution of the order. Thanks to the well-coordinated work, they will deliver the cargo to the destination on time, without delay.

4. Security. The client does not risk anything by entrusting the execution of the order to a reliable company. The full responsibility of the transport operator for the safety of delivery.

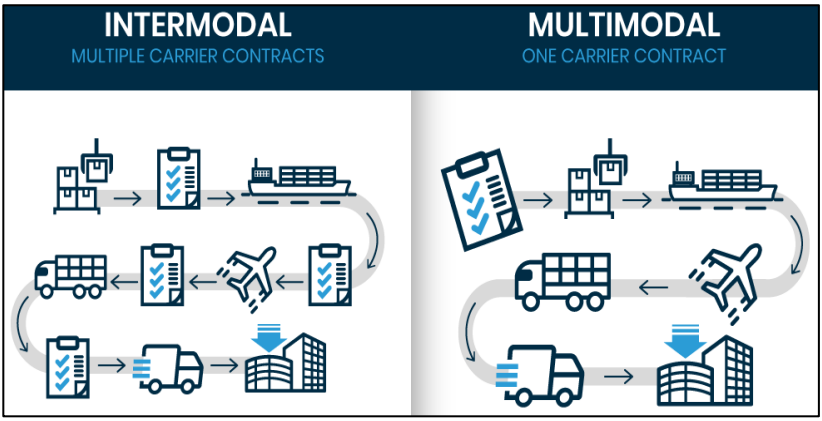

Figure 2 – Intermodal and Multimodal Transportation

The Republic of Belarus implements a multi-vector foreign economic policy and actively participates in international integration processes. Belarus is an export-oriented state with a well-developed manufacturing sector and agriculture. 61% of the products produced are exported. Belarus maintains trade relations with more than 200 countries around the world [3].

The commodity structure of Belarusian exports includes more than 1000 commodity items. The most important export items are oil and refined products, potash and nitrogen fertilizers, metal products, trucks and cars, tractors, tires, dairy and meat products, furniture.

By the end of 2020, according to Belstat, the foreign trade turnover of goods of the end of 2019 – 72,278. 4), including exports – 29,040. 5 million dollars, imports – 32,618. 8 million dollars. If compared with the level of 2019, based on current prices, the turnover of foreign trade in goods amounted to 85.1%. Exports – 88.1%, imports-82.6%. According to the results of 2020, compared to 2019, exports of goods in physical terms decreased Republic of Belarus amounted to 61,659. 3 million US dollars by 0.4%. Imports decreased by 9.5%.

Average export prices decreased by 11.5%, while import prices decreased by 8.7% [4].

In practice, when determining the route, a combination of several modes of transport is used:

–marine-automobile;

–marine-railway-automobile;

–sea-rail;

–air-road;

–air-railway;

–air-railway-automobile.

International cooperation in the field of logistics will increase the volume and improve the quality of logistics services in the Republic of Belarus. This cooperation can be developed within the framework of a strategic partnership between Belarusian and foreign participants in logistics activities, including in the implementation of the "One Belt and One Road" initiative [1].

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УДК 811.111:629.33|313|

Aniskevich A., Pinchuk I.

Comparison of a Gasoline Engine and a Diesel Engine

Belarusian National Technical University
Minsk, Belarus

Nowadays petrol engines are used in the majority of cars, and that's why it's very important to know everything about their advantages and disadvantages. The majority of car admirers choose petrol engines because of their low cost and weight, compared to diesel engines. A petrol engine is started due to fuel-air mix, which is ignited by a spark from spark plugs, burning (Figure 1) [1].

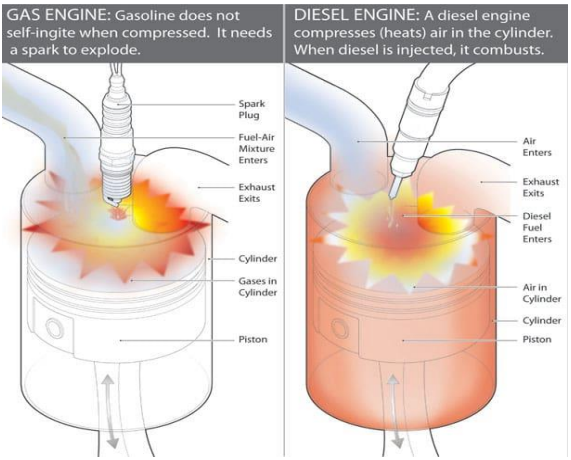

Figure 1 – Gas Engine vs Diesel Engine

Relatively low compression ratio, which has a value of 8 – 12 points, appears in a combustion chamber. The absence of heightened loads allows to make the engine easier as the same safety margin that diesel engines have is not required. But

petrol has some advantages, and one of them is the absence of need of additives even at very low temperature. Talking about diesel fuel is a completely different story? Also, the petrol one is easier to start in winter and requires less time to warm up. Another essential factor is noise and engine vibrations. Speaking of which, petrol engines are much more advantageous than diesel ones. The issue of diesel engines that significantly increases vibrations and causes rumbling that can't be silenced by any soundproof or dampers is the process of ignition being under a lot of pressure. In terms of fire safety, petrol engines are more prone to fire and explosions. Therefore, it requires more attention to leak proofness of the fuel system and condition of electrical equipment [2].

Figure 2 – Comparison of Gas Engine and Diesel Engine

Talking about requirements of the quality of fuel, petrol engines are less demanding and usually run on fuel which has a lower octane number. On the contrary, diesel engines always require fuel of high quality as a proactive way of preventing fuel pump and injector from clogging. What is more, diesel requires high quality filters in good condition as well as timeliness of their replacement, which makes car users contact car services more often. One of the possible advantages of diesel fuel is its price, but the ratio of prices is different and

really dependent on the country where you live and exploit your car in [3].

Let's consider the advantages and disadvantages of diesel fuel (Table 1).

Table 1 – Advantages and Disadvantages of Diesel Fuel

Advantages	**Disadvantages**
A simple construction	More prone to fire and explosions
Low weight	More demanding for high quality oil
Low cost	The more car is loaded, the more fuel is consumed
An opportunity to exploit at high revs	
Easier to service	
Makes less noise	
Easier to start at low temperature	
Less demanding for fuel quality	
More opportunities for refurbishment to decrease fuel consumption	

Taking into account all specific characteristics of petrol and diesel engines, it is possible to make a conclusion that both of them have their own pros and cons. To cut a long story short, petrol is more suitable for passenger cars, while diesel is often chosen for commercial vehicles and SUV (Sports Utility Vehicles). Your choice should be dependent on your personal needs and clauses of exploitation.

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УДК 811.111:378.147.018.43:004

Baida I., Korzun O.

West-Point Military Academy

Belarusian National Technical University
Minsk, Belarus

Why is the Academy called West Point? Because it is located in the city of West Point, the State of New York, 80 km to the North of New York. Besides, the oldest museum of the US Army is also located here. A military fort was built by order of George Washington on the territory of the academy in 1778. The project was drawn up... by Tadeusz Kosciuszko, a national hero of Poland. The main task facing the fort was not to miss the ships of the British fleet along the Hudson River and a large chain was stretched across the river for doing this. This fort played a key role in the US War of Independence.

The Academy itself was founded in 1802. Great importance was initially attached to engineering. In the first half of the 19th century West Point graduates designed most of the US roads, bridges and railroads.

In 1976, women were admitted to the academy for training for the first time.

Candidates for admission should apply to the academy directly, but at the same time receive a letter of reference, usually from a member of Congress. Students have the status of studying officers and are addressed as the Cadet. Training at the Military Academy is free of charge for the cadets, but the graduates must go on active military service as officers. Cadets of the academy are obliged to follow strictly the Code of Honor, which states: "Thou shall not lie, steal or cheat".

Currently, the vice-president of the United States and each of the congressmen have five studying places in the academy. When one of places is released due to the completion of the cadet's studies or for other reasons, the congressman recommends one or more people to the vacated place. Most often, these are ten people. If he recommends several people, a contest is held between them. If he recommends one person, he is recognized as suitable for training and admitted to the Academy automatically. The process of receiving a recommendation usually involves submitting an application, writing one or more essays and submitting letters of reference.

In addition, 100 places are provided each year for the children of officers, 170 places for soldiers on active military duty, 20 for cadets of the reserve officer training corps and 65 for the children of those who were seriously wounded and became disabled, died in battle or missing. In addition, about 20 foreign cadets are admitted each year.

A person entering the academy must be aged between 17 and 22 years old, unmarried and not paying alimony. The training lasts 4 years. A graduate of the academy receives a Bachelor's degree and is commissioned as junior lieutenant (Second Lieutenant) with an obligation to serve in the army for 5 years. Every year about 900 lieutenants graduates from the Academy. The Cadet Corps is officially organized into a brigade. The brigade commander is traditionally known as the First Captain. The brigade consists of four regiments. Each regiment has three battalions of three companies each. Companies are indicated by letters A to I, and the number means which regiment they belong to.

Cadets are not called freshmen, sophomores, third-year students and seniors. Instead, they are officially called fourth, third, second and first class cadets. At the local slang, freshmen are plebeians, sophomores are annual or

yuks, the third course is unexpectedly "cows," and the last course is "first men".

Since 2015, cadets have received a monthly scholarship of $1,017 for books, uniforms and other things. This amount is automatically deducted for the cost of uniforms, books, supplies, services, meals and other miscellaneous expenses. All money remaining after deductions is used as the cadets wish. The commander at the Academy is the superintendent. The Academy is a direct subordinate unit, and as such the superintendent reports directly to the chief of staff of the Army. In recent years, the post of superintendent has been held by a lieutenant general. Now this honorary position is held by the 60th Superintendent, Lieutenant General Darryl A. Williams.

The US Military Academy cooperates with a number of higher educational institutions in Russia. Among them is Voronezh State University. West Point is lays a great emphasis on sports achievements. Not surprisingly, the academy has 15 men's and 9 women's sports teams of the National Student Athletic Association. And some teams (for example, American football) were successful.

The graduates of West Point receive an individual ring - and this is generally a wonderful tradition. There are also some other traditions at West Point. On the outskirts of the Academy, there is a monument to Civil War General John Sedgwick. Sedgwick's bronze statue has spurs with freely rotating ridges. The legend says that if a cadet is threatened with failure in the exam, he must wear a dress uniform in the evening before this very exam. The cadet comes to the statue and spins scallops at exactly midnight (and it is forbidden to leave the barracks at night). Then the cadet returns to the barracks as soon as possible. According to legend, if Sedgwick's ghost catches him, he won't pass the exam. Otherwise, the cadet passes the exam.

УДК 620.95=111

Bruveris M., Korzun O.

Incineration

Belarusian National Technical University
Minsk, Belarus

In the modern world humanity faces a number of problems that need to be solved. One of them is the increasing pollution of the environment. If we talk about the problems of garbage and the lack of natural resources, then, incinerators are an excellent solution. Industrial incineration appeared in Great Britain in the second half of the 19th century, when incinerators were built at factories.

In 1874, the world's first incineration plant was built in Nottingham, and then the first steam plant was built there, where waste was used as fuel – this is how industrial incineration first found energy use. Garbage at that time was burned in bulk, without sorting, and filtration systems did not yet exist in furnaces and factories [1].

To date, there are more than two thousand waste incineration plants in the world, of which more than four hundred are located in Europe. The undisputed leaders in waste incineration are Switzerland, Finland and Sweden, where there is a well-established waste sorting system, which makes it possible to use waste as a fuel at a lower cost in this type of power plant.

There are two main technologies for waste incineration: layer combustion (first used in 1930 in Switzerland) and pyrolysis (used since the 50s of the last century). The main feature of layer combustion is the distribution of waste in the furnace in a uniform layer, to which hot air streams are supplied, which ensures uniform combustion. A layer of debris is loaded

into the combustion chamber and placed on the grate or air distribution grate. Typically, the combustion chamber is in the shape of a parallelepiped. When using a grate, it is installed at an angle, in which the grates are arranged in a cascade like a tiled roof. In the vertical plane between the grates there are slots or nozzles through which air is supplied. Depending on the chemical composition of the waste, incineration can be carried out at temperatures ranging from 800 to 1500^0C. Most often, layered combustion on a movable inclined grate is used.

This technology allows you to incinerate any type of waste, except for dusty waste. The air in the combustion chamber is supplied in the same direction as the movement of the debris, also contributing to its movement. At the lowest grate, the combustion process is completed, and ash and slag through the grooves spill into a special tank cooled by water, and then disposed of. One chamber with a movable grate is capable of processing about 35 tons of waste per hour [2].

Pyrolysis is used for the disposal of toxic waste: some types of plastics, rubber, and a number of industrial waste. The technology of low-temperature pyrolysis is more widespread, in which waste decomposition occurs at temperatures below 900^0C (usually 400-600^0C). The pyrolysis furnace, in which the waste is processed, consists of two combustion chambers: a lower waste incineration chamber and an upper generator gas afterburner. Before being loaded into the furnace, the mass of waste is crushed and then placed in the lower chamber, where it is burned in an oxygen-free environment. The gases formed during the decomposition are directed through the injector device to the afterburner, where oxygen and catalytic gases are supplied in limited quantities. There, further decomposition of gases takes place, as a result of which the content of toxic substances in emissions during pyrolysis is approximately 7 times lower than the maximum permissible concentrations.

Thus, the effectiveness of the pyrolysis technology lies in the reduction of the amount of harmful emissions and the destruction of biologically active substances, which allows further storage of pyrolysis waste without much harm to the environment. In addition, solid sediment, as well as liquids and gases formed as a result of waste pyrolysis, can be used as raw materials in the chemical industry or as fuel, thereby recycling waste.

In incinerators, emissions of dioxins (one of the most toxic technological substances) are filtered mainly by adsorption (mainly activated carbon). Also, for the splitting of dioxins and furans, secondary combustion of gases is used, since the temperature in the primary combustion chamber of garbage is not high enough. This allows you to significantly reduce the level of pollution from incinerators, thereby allowing them to be located directly in large cities – a potential source of their future fuel [3].

Incinerators have their drawbacks, such as: environmental pollution, although to a lesser extent than any thermal power plants; is not a complete solution to the waste problem, since ash residues need to be reburied, albeit in much smaller volumes, at this time; the cost of their construction is still high, although they pay off in 15-20 years with minimal risk to the environment – they are still an excellent solution to the problems of waste and lack of natural resources.

Perhaps, with the increased attention of scientists and engineers to this type of energy production, we will see incinerators not only in developed countries of Europe and Asia, but also in countries with weaker economies. Since incinerators have little impact on the environment, their ubiquity will soon be able to solve the greatest problem of humanity – global warming.

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Gritsuk A., Kondratuyk E., Korzun O.

Charity in Business

Belarusian National Technical University
Minsk, Belarus

Socially significant activities go in different ways. We are motivated to do charity work by the desire to change the world for the better. However, in business, charity helps to attract employees, customers, develop their image, and thus contributes to business growth. This is confirmed by real cases, examples of which you will find below.

What is traditional charity?

The traditional charity includes:

Fundraising – the collection of voluntary donations in cash or other form for charitable activities organized by the company itself;

Sponsorship – the provision of resources in cash or other form to a non-profit / charitable organization to support its activities (for example, holding charity events);

Grant management – increasing the employee's charitable contributions from the company's funds or providing funds to the employee so that he or she can donate them to a non-profit organization that he or she chooses;

Endowment – collection of donations for a non-profit organization (NPO) which are transferred to the management company to finance the legal activities of a non-profit organization (for example, the formation of a salary fund for corporate social responsibility managers who establish business processes in commercial companies).

The foundation of any charitable activity is employees. Without their initiative or interest, it is impossible to develop

corporate social responsibility. From this point of view, traditional charity is the simplest way to involve employees into charitable activities: they do not need to spend a lot of their time, effort and emotional energy. Traditional charity is a quick start to the development of a CSR (corporate social responsibility) culture in the company.

What business purposes does traditional charity fulfill?

Companies involved in the charity show to the whole society and its customers that they are trustworthy, as well as the fact that the company conducts its activities ethically, taking care of society, culture and the environment. Charity is a tool for detaching itself from competitors and helps attract both talented applicants and new consumers.

People are really willing to support companies, knowing that the business donates part of the profits to charity. For example, the outdoor clothing brand Patagonia has pledged to donate 100% of its sales revenue after Black Friday in 2016 to environmental nonprofits. The company expected sales of $ 2 million, but the company's initiative was supported, and as a result, its revenue amounted to $ 10 million [1].

Another company, Warby Parker, increased brand appeal and customer loyalty, and an increase in sales. The company donated similar frames from each pair of glasses sold to non-profit organizations around the world to provide residents of poor countries with optics.

Developing relationships with employees

Many people want to help those in need, but they can't find the time or simply don't know how to do it. Participation in events organized or partially sponsored by employers allows employees to engage in charity work without remorse that they spend less time with their family / friends or have given up sports.

Employees of the top 1000 companies according to Fortune say that they would like to participate in socially

significant activities of the company. For example, they believe that making donations and engaging in volunteering will help them in personal development and strengthen relationships with colleagues [1].

Team Building

When raising funds, employees traditionally interact with colleagues from other departments, get acquainted with those whom they did not know before. Later, "like-minded people" begin to communicate outside of work, which contributes to the unity of the team of the entire company, as well as the development of its corporate values.

Retention of employees by increasing their engagement

When a company gives employees opportunities to express themselves, it inspires them with a sense of pride for themselves and their organization. Namely, a sense of belonging to the company and sharing its values increases their loyalty and, as a result, employee engagement. A well-developed corporate culture contributes to employee retention. According to an internal survey by O. C. Tanner, 78% of employees who participate in charity events fully share the company's values and say that they are proud of it. At the same time, 57% of respondents believe that due to participation in socially significant activities, their mood has improved and there is an emotional charge [2].

Building business partnerships

Participation in charity events organized by several companies expands the network of contacts of participants as well as allows you to build relationships between companies and conduct co-branded promotions.

In 2012 Land Rover sponsored the project "Hero" created jointly with the NPO Red Cross. The project was created to show that with the help of the new Land Rover model, it is possible to help people in hard-to-reach areas of the population. So the company launched a campaign to move from

Birmingham to Beijing with the famous Norwegian traveler Bear Grylls and also provided several vehicles to NPOs for rescue work. This provided excellent product positioning for Land Rover, as the company showed its car in action and justified this by the social significance of the project.

In conclusion, it should be noted that socially significant activities have a positive effect on the financial performance of the organization in the long term due to the development and retention of employees.

It is expected that over the next two years, the global volume of donations from corporate employees to NPOs will grow by 25%. Employees are looking for new ways to maintain balance and personal life, so they are starting to try something new, in particular, they are more actively involved in corporate charity and volunteering.

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Kuchkin K., Korzun O.

Ice Aircraft Carrier

Belarusian National Technical University
Minsk, Belarus

In 1942, the situation on the Western front was catastrophic for Great Britain. British fleet had significant losses. Germany's powerful industry allowed the country to recover quickly after its losses, while Britain, having entered the war insufficiently prepared, took into account any, even the most insane ideas that could help it confront the enemy [1].

One of such ideas became the creation of the aircraft carrier made of glass. Ice as a construction material was considered as a temporary replacement for steel that was in great demand at that time. It is known that in 1942 this idea was discussed at high level in the United Kingdom, including the Prime Minister Winston Churchill.

Two ways of the creation of an aircraft carrier from ice were developed at the same time. The first - the cheapest - was to sawn off the tip of a large iceberg and convert its surface into a runway. It was assumed that such ships, very cheap in production, would be used for air operations against strategic enemy targets. Such an iceberg aircraft carrier was also supposed to be equipped with defense systems, residential compartments and an engine with control rudders. The time to use such a ship would be limited to several months.

The second way supposed the construction of an aircraft carrier from ice blocks, between which refrigeration

pipes would run, and that would allow the ship not to melt and perform its functions for a long time.

After a long discussion, the British Department of Defense chose the second option as the most promising. Jeffrey Pike was appointed project manager. Experimentally, he found that if you mix water with cellulose and then freeze, you could obtain ice that is superior in strength and does not melt for more time. The new material, which, as it turned out later, had even greater buoyancy, was decided to call "pykret." The American and Canadian allies were involved in the British project, and just in two months, the model of the ship was built and launched in Canada, where its tests began.

By 1943, the 18-meter vessel was successfully tested in summer conditions, but the English Admiralty had several questions to engineers: they asked to increase the strength of the deck to land heavy bombers and equip the vessel with additional protection against the torpedoes of German submarines. It was necessary to strengthen the metal frame of the ship, which resulted in additional cash, and time costs. The project no longer seemed a way out against Germany's superiority at sea, especially since by the end of 1943 the situation in the war became favorable to the Allies. Britain finally managed to overcome the shortage of steel and establish the production of cheap aircraft carrying ships. The unusual project was gradually forgotten and remained only in the form of drawings. The test copy of the ship soon melted, and only a metal skeleton frame was left.

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Sharapa N., Novik P., Korzun O.

Military Interpreter

Belarusian National Technical University
Minsk, Belarus

War is a terrible and difficult test for every country. To protect our homeland, we need professional military personnel. Military interpreters are among them.

A military interpreter is a staff officer, a specialist in writing, interpretation and simultaneous interpretation, connected with various aspects of military service.

Historical background

The first translators in Belarus appeared in the time of the Polotsk Principality. They served as royal servants and were needed to communicate with other princes, as well as with merchants.

The first military interpreters appeared during the reign of Peter I. At that time special importance was given to the international military influence of Russia, so all officers must be taught the basics of a foreign language. Special training courses were set up for this purpose.

In the next century, officers were trained at the School of Translators at the Asian Department of the Ministry of Foreign Affairs (1885). After graduation, all of them were sent to the border areas of the Russian Empire. In 1899, due to growing demand, an additional branch of the school was opened in the city of Vladivostok.

The school trained specialists who spoke English, German, French, Japanese, Chinese or Korean. The high level of knowledge was also facilitated by the home education system adopted in the Russian Empire at that time, which laid

the emphasis on the learning foreign languages. Thanks to this approach, Russian officers could interrogate prisoners on their own during the First World War.

The revolution of 1917 changed the situation drastically. People who could speak foreign languages were in great demand. So, a new specialty - the military interpreter - was created on the 21 of May, 1929. The need for such specialists became even greater in 1940, before the forthcoming war, and the Military Institute of Foreign Languages was opened.

During the Second World War, the institute managed to train more than 5,000 specialists. They interrogated prisoners at the headquarters and, along with other military personnel, participated in offensive operations. At the end of the war, the profession remained in demand, and the training program was improved every year. Military interpreters today take part in all the conflicts in which Russia participates and negotiate under the most difficult conditions [1].

Military interpreters in Belarus

To become a military interpreter in the Belarusian Army today is necessary to study the following subjects: "linguistics and intercultural communication", "acquisition and processing of foreign military information", "analysis of foreign military information", etc. Today the following universities train military interpreters: Belarusian State University, Minsk State Linguistic University, Gomel State University, and etc. [2].

A military interpreter must combine professional knowledge and practical skills to perform his official duties. He must also know military affairs in order to be able to work in any branch of the Armed Forces and to translate any military document.

Another distinctive feature of interpreter’s work is constant business trips. All tasks are performed by order of the command. Once the work is complete, the interpreter must

report about it and begin the implementation of a new one. This transition is inevitably associated with a change of location.

The last peculiarity of the profession is regular retraining in training centers for the period from 3 to 12 months. Such training is also one of the obligatory tasks given by the command [3].

It should also be mentioned about such useful skills of any interpreter as: the ability to encrypt and encode data, to analyze quickly the contents of a long speech, to code all the information with different symbols (or abbreviations) and easily reproduce it when necessary. All interpreters have usually their own symbols which they develop over the years.

Whatever the situation in the country is, people's safety will always come first. Military interpreters have always stood on the guard of our security. The skills and knowledge of interpreters all enable them to serve the Nation in the future, as they have done in the past.

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Shevernev V, Korobkov I, Korzun O.

Paradox of Frugality

Belarusian National Technical University
Minsk, Belarus

The coronavirus crisis has led to record savings growth in both developed and developing countries. For example, in the United States, the savings rate rose to 33% compared to 7.5% in 2019. In Russia, savings increased by 18.2%, in other words, four times more than it was in the same period of 2019-2020.

According to the classical theory, a high tendency to save allows the nation to flourish, since large savings increase investments. Keynes concluded that in the countries with a high level of economic development, the desire to save is always ahead of the desire to invest for several reasons:

– increased capital accumulation reduces its marginal efficiency;

– the increase in income leads to the increase in the share of savings, since savings are an increasing function of income;

– the decrease in consumer spending will cause the increase in unrealized products, production and national income will begin to decline;

– the multiplier effect will cause a much larger decline in income with a slight increase in savings.

The essence of the frugality paradox is that society's attempts to increase savings may be in vain, since equilibrium income will decline many times [1].

Frugality, being a good characteristics of a person, is considered as evil when we take society as a whole, as it adversely affects employment and total output.

In most cases, households have substantial incentives for more savings at a time when increasing savings is not economically feasible, when the economy is in decline. Assuming that the money market more effectively links savings and investment decisions, that is, converts savings into investments, the upward shift in the savings curve will be equal to the same shift in the investment curve, which will keep equilibrium national income unchanged. Thus, employment and production will not change, and the production structure will consist of more investment goods than consumer goods, which will allow future economic growth to accelerate.

Meanwhile, if the economy works in the classic segment of the aggregate supply curve, or, in other words, it is in the stage of demand inflation, then the tendency of households to save more will shift the aggregate demand curve down, and therefore the rate of inflation will decrease. In this case, an increase in savings is desirable, since it will stop inflation. From the simple Keynesian model, it follows that economic growth requires an increase in aggregate spending reviving the growth of aggregate income with a multiplier effect. Everything withdrawn from spending reduces total income, thereby driving the economy to a state of depression or recession. Therefore, the paradoxical conclusion follows from all this: the more people begin to save, the poorer the economy becomes [2].

Keynes believed that the getting out of the recession was state active intervention in the economy, i.e. implementation of government regulation policies. To stabilize the economy, Keynes proposed increasing government spending, as this allows you to directly affect aggregate demand and influence aggregate income and output. The paradox of frugality in its pure form is observed only in the Keynesian model.

According to the classical theory savings are equal to investments. That is why the increase in savings leads to the

increase in investments by the same amount, and there is no decrease in income. If the discharge limit is increased due to the growth of any type of discharge, then this difference is compensated by the corresponding increase in investments, and therefore the total output remains unchanged.

The representatives of the Austrian school believe that savings, that is, the refusal to acquire the current benefits in return for greater acquisition in the future, are the basis for economic development and can lead to great wealth.

In conclusion, it should be noted that frugality is an integral part of economic development. The foundations of economic development are needed to be constantly strengthened to achieve sustainable wealth and prosperity of the Nation to realize the aspiration of future generations.

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Bogomoltsev M., Slesarenok E.

Mining Dump Trucks Komatsu

Belarusian National Technical University
Minsk, Belarus

Today freight transport is one of the most popular types of special equipment. Its main advantages are functionality, market liquidity and versatility. A dump truck (or as also known as a tipper truck) is classified as a special machinery and is used for transporting dumps and taking dumps, big ones (such as sand, gravel, or demolition waste) used in construction, as well as coal and in other activities. A typical dump truck is equipped with an open-box bed, which is hinged at the rear and equipped with hydraulic rams to lift the front, allowing the material in the bed to be deposited ("dumped") on the ground behind the truck at the site of delivery.

The world leader in the production of construction and mining equipment is the Japanese multinational engineering corporation Komatsu Ltd. Komatsu principles of work: quality, reliability, safety, environmental friendliness and innovation. All Komatsu dump trucks are divided into two drive groups: hydromechanical and electric transmission. A distinctive feature of the front suspension of all Komatsu dump trucks is the use of a McPherson design with a support arm and a shock absorber attachment to the upper support. This suspension provides both empty and fully loaded vehicles with the same high quality of ride and is not by any other competitors in the world. Due to the relative simplicity of the design, dump trucks with a hydromechanical drive have historically been widely used. Komatsu's production program includes the

production of HD (hydromechanical drive) dump trucks from 36.5 to 141.9 tons (Table 1).

Table 1 – Specifications of Komatsu HD1500-8

Gross vehicle weight (Includes optional equipment, operator (75 kg) and payload)	249 575 kg
Rated payload	142 t
Body Capacity	78 m^3
Displacement	50 l
Engine power ISO 9249 / SAE J1349* (net engine power)	1103 kW/1500 HP
Engine power SAE J1995	1175 kW/1598 HP
Max. travel speed	56,5 km/h
Minimum turning radius	11,2 m

This model has the most powerful retarder in its class. The truck is equipped with an Electronic Stability Control to optimize handling on slippery and / or soft surfaces. The model includes the latest energy-saving technologies, as well as an ECO-mode indicator that helps a driver to work economically.

The main frame, transmission, rear axle have been redesigned, which makes the model more durable and reduces repair costs. The radiator is lead-free and meets international environmental protection requirements. The use of hydromechanical transmission limits the carrying capacity of vehicles, and modern technological processes of open pit mining require dump trucks of higher carrying capacity. The electric transmission helps to lift it. Komatsu mining haulers with electric transmission are marked with the letter E. Recently, alternators and DC motors are giving way to alternators in these transmissions. These transmissions not only provide higher performance, but also are more compact.

Electronic transmissions are used in Komatsu 730E, 830E, 860E, 930E, 960E, 980E machines. The Komatsu 730E

family is a true long-liver. The first dump truck of this type was assembled back in 1996 (Table 2).

Table 2 – Specifications of Komatsu 730E

Gross vehicle weight (Includes optional equipment, operator (75 kg) and payload)	328,401 kg
Rated payload	181.4 t
Body Capacity	111 m3
Displacement	50 l
Engine power ISO 9249 / SAE J1349* (net engine power)	1405 kW / (1910.3 HP)
Engine power SAE J1995	1492 kW/2029 HP
Max. travel speed	55 km/h
Minimum turning radius	13,6 m

An improved fuel system reduces noise and vibration levels for improved reliability and performance. The deceleration system provides the effective braking required for safe movement in steep slopes and ascents of mining quarries.

The automatic speed control adjusts the speed of each individual wheel, allowing a driver to make adjustments at any time while driving in difficult road conditions. A state-of-the-art monitoring system identifies maintenance periods and faulty parts, this reduces diagnostic time, indicates oil and filter change times, and displays fault codes to improve machine operating performance. The company also manufactures the Komatsu 980E-4 electromechanical transmission haulage truck, capable of carrying loads of up to 369 tonnes. This is the largest dump truck ever produced by Komatsu. 18-cylinder Komatsu SSDA18V170 3500hp diesel engine weighs 11.8 tonnes. Komatsu's new flagship is designed to work with giant mining excavators that can load it in 3-4 buckets. The truck's hydraulic system has fewer components than other manufacturers, so the design is simpler and more reliable (Table 3).

Table 3 – Specifications of Komatsu 980E

Gross vehicle weight (Includes optional equipment, operator (75 kg) and payload)	625,277 kg
Rated payload	369.4 t
Body Capacity	250 m3
Displacement	53 l
Engine power ISO 9249 / SAE J1349* (net engine power)	2495 kW / (3393 HP)
Engine power SAE J1995	2610 kW/3500 HP
Max. travel speed	61 km/h
Minimum turning radius	15.9 m

Another novelty that represents the future of the industry is the Komatsu IAHV autonomous mining dump truck, developed as part of the Innovative Autonomous Haulage Vehicle project for testing serial unmanned technologies. The dump truck was not a complete stand-alone product, but was proposed as part of the Autonomous Haulage System (AHS). It cannot be bought without a management system for an autonomous cargo transportation complex. The absence of a cab made it possible to maximize the 15-meter length for the entire U-bottom body [1]. The use of dump trucks reduces the cost per ton-kilometer of goods transported. Expanding the fleet of these machines will increase productivity and reduce transportation costs. Komatsu is rapidly inventing heavyweight models and introducing them to the world.

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Feoktistova M., Bondarenko A., Slesarenok E.

Development of Self-driving Cars

Belarusian National Technical University
Minsk, Belarus

Currently, there is an era of high technologies and automation of almost all types of activities. Computers are performing a huge part of our work, both in everyday life and in the professional sphere. The development of traffic control and traffic flows without involving operators in the driving process, implies a new level of design and application of new developments.

What functions does a self-driving car have? It can perform a lot of things that are not available to conventional cars. First of all, it moves completely independently from point A to point B, and chooses the best route, taking into account not only the map data, but also information from the Internet about traffic jams. Secondly, it independently regulates the speed, brakes when cornering and accelerates on straight sections of the path. It also finds a free parking space and parks on its own. Thirdly, a self-driving car identify other vehicles, clearly "sees" through fog, snow and rain, notices road signs and traffic lights. The principle of operation of a self-driving car is carried out by constant scanning of the territory using sensors: lidars (laser radars), cameras, radars and high-precision maps – necessary conditions for autonomous vehicle movement. The self-driving car system interacts with the Street View service, which gives a panoramic view of the city streets from a height of 2.5 m [1].

The idea for the development appeared back in the 30s of the XX century, when the engineers of the General Motors

company came up with two brilliant ideas for that time. The first idea was that the cars were controlled by radio signals. So they were to control the distance on the track and avoid emergencies.

The second idea was more interesting - in order to organize self-driving trip, it was necessary to build special tracks in the form of skateboard ramps. Cars went in the middle, and if they start to lean to the side of the road, the force of gravity will returned them to their place. Although the ideas were met with skepticism, they provided a powerful rise for the development of technology in the right direction.

General motors Firebird II - the first car in the world with a cruise control system. Already in the 50s, General Motors technologists tested the "smart" car Firebird II, which, in addition to the new braking system, had magnetic sensors and interacted with the "smart" road (with an electric cable under the asphalt). Version 3 of this car was equipped with the first autopilot system known today as cruise control. This system was responsible for maintaining a constant speed and facilitated the driver's tasks on the road. But the autopilot was still a long way off. The year 1961 went down in self-driving history when Stanford student James Adams created and tested the first self-driving carriage. It was controlled by a conventional signal through a cable.

This experiment wasn’t left unnoticed, and in the 1970s, the scientist J. McCarthy equipped it with a technological vision system. Now the cart could move independently and focus on the white line. And in the 70s, he tried to create three-dimensional mapping of the area.

Following McCarthy's successes, the efforts of engineers were thrown into creating a 100% autonomous vehicle without remote control. Scientists from the United States and Japan achieved significant success, but the real breakthrough was made by German researchers led by Ernst Dyckmans.

In fact, their development was a model of a machine mechanism, capable of adequately assessing the entire environment. On the basis of Dickmans' developments from 1987 to 1995, the project “Prometheus” was in operation, aimed at improving self-driving vehicles. More than $ 1 billion was invested in this project, making it the most expensive robotic car project in history. In 1994, the car "VAmP" Mercedes equipped with Dickmans technologies for several hours independently at a speed of up to 130 km/h moved along the streets of Paris, turned, overtook other cars and changed lanes from one lane to another.

Google's achievement was the ability of the car to set your own route, navigate the territory and respond to other road users, including pedestrians. In 2012, the company reported that its self-driving cars covered 480,000 km without a single accident. However, the participation of such vehicles in the general flow of traffic creates obstacles for other drivers (extremely cautious Google cars often collect the "tails" of traffic jams). Also, Google cars cannot move in bad weather conditions, they are also unable to recognize temporary traffic signals, they cannot distinguish police from ordinary pedestrians, etc. But the developers promise that these disadvantages will be removed.

Over the past 10 years, self-driving cars have developed at a tremendous rate. One example is the TOYOTA CONCEPT-I.

A distinctive feature of the car is the presence of an artificial intelligence system. The on-board computer has a built-in Yui agent, the main task of which is to create the most natural relationship between the car and the person. Concept-i can conduct a dialogue with a person using voice, light, and holograms. Yui can also output some words on the side doors. The Toyota Concept-i is a self-driving car, but the developer has kept the steering wheel and pedals for control. Interesting

car details: teardrop shape for improved drag, lifting doors like sports cars, the presence of an electric motor, which is enough for 300 km.

Constantly self-learning artificial intelligence Yui can adjust to the driver, change the climate, switch settings and recognize the emotional state of a person. Yui doesn't just study you and make your trip comfortable for your family, it can even anticipate your expectations - and, for example, offer you the right music at the right time.

And, as it turned out, this is not the limit in the development of self-driving cars. In 2020, Honda announced an autopilot that works in traffic jams [2].

This relatively minor news was one of the few bright spots for automakers. The Honda Legend will have a built-in "autopilot for traffic jams", which will allow you to be distracted while driving in heavy traffic. When you get out of it, you'll have to drive yourself again. While many companies promised to release similar systems, and then took their promises back, Honda is going to release a robotic car and the company is ready to take full responsibility for it. Given the fact that once existing self-driving cars seemed to us a fiction, and now they are available in multi-million cities, we should not exclude that this technology will become a reality in the coming years. Self-driving cars to this day do not cease to surprise people with new developments, which only confirms their promising future and rapid development.

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Gorelova N., Shpuntova E., Slesarenok E.

Strategic Planning of Supply Chains in Modern Business

Belarusian National Technical University
Minsk, Belarus

In the modern logistics business, there is an effective process of organizing and managing the chain of spacers. The formed supply chains perform the functions of exchange and distribution, and they also determine the dynamics of financial, information and inventory flows in the implementation of the production process. Effective management is impossible without strategic planning of enterprises activities, without a holistic definition and continuous monitoring of supply goals. It should be under line that strategic planning is the process of developing and maintaining a balance between common goals and supply chain capabilities in a rapidly changing environment. The main goal of strategic planning is to determine the main directions of supply chains that ensure its efficiency and competitiveness.

Planning is divided into several levels, such as: 1) The first level is defined by the supply chain. The activity of planning at the first level is to define the purpose, mission and goal, as well as the definition of strategies. Thus, the basic tasks of this level are: defining the mission, formulating the concept, and defining the goals and objectives of the supply chain. 2) Formation of the supply chain configuration. It consists in determining the form of organization of the supply chain and distribution network, the choice of suppliers, sales programs, the choice of raw materials and materials, places of purchase, the structure of supplies and distribution. The goal of this level of planning is to minimize the costs in the supply

chain, as well as the costs of production, procurement, storage, and transportation. 3) The third level includes the strategies of enterprises that are part of the supply chain. At this level, strategies for their field are developed, based on a single supply chain plan, the main goal of which is to increase the competitiveness of enterprises and their competitive potential. These three levels of planning are interrelated.

Strategic planning includes stages: supply chain resource analysis; creating prerequisites for changing the state of the supply chain by viewing its mission and goals; refine strategic objectives based on supply chain threats and opportunities; strategy development; coordination of the strategy; development of supply chain enterprise policies; monitoring and evaluating the performance of the supply chain. And it is also worth considering the elements of supply chains. These elements include: resources, physical and human resources, as well as information resources, marketing resources, organizational resources, and legal resources. All these resources can take different forms. They can be both tangible and intangible, as well as organizational capabilities [1].

The main task in forming a strategic plan is to establish a balance between the indicators of the supply chain-total costs and the level of service, in order to assess the possibility of improving the service, taking into account the set limits on the amount of costs throughout the supply chain. And also, the planning tasks include: determination of the most profitable period for the implementation of changes; determining the optimal location of new regional warehouses and distribution centers; determining the level of inventory in the supply chain; identification of sources of supply of raw materials and materials; calculation of the level of stocks of raw materials and materials; evaluation of the application of various pricing policy options; identification of sources of financial resources and options for their placement. Basically, these tasks are

competing. Strategic supply chain planning begins with modeling. A supply chain model is a simplified representation of a supply chain consisting of: supply chain facilities; the shoulders connecting these objects; transformation processes and resources; material values and finances that form material and financial flows; model parameters and constraints. The modeling process consists of the main steps: creating a supply chain model, optimizing the model parameters. Optimization of the model is finding the best solution to the existing constraints on the given factors: maximum profit, maximum income. Depending on the type of model, the most appropriate optimization algorithm is selected. The main types of models: speculative (heuristic); physical (full-scale); descriptive; verbal; graphic; mathematical methods; simulation models; mathematical programming. The key features of these methods are: determinism; dynamism; optimality. In modern business, the most common model is mathematical programming. This method is the most successful. Mathematical programming has been used for a long time in industry, agriculture, logistics, and the healthcare system.

In modern business, strategic planning is of great importance. A huge number of enterprises single out the organization and management of supply chains as the most important factor. And it becomes clear that there is a need to manage, plan, and optimize supply chains. Supply chain management is a strategy in modern business that provides management of all flows, financial, information, and material, to ensure their synchronicity in the structures of the organization.

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Harnak I., Falovskij A., Slesarenok E.

Why Electric Car Is not Environmentally Friendly

Belarusian National Technical University
Minsk, Belarus

Cars are an essential part of many people's lives nowadays. Since their appearance many things have changed. Recently, electric vehicles are gaining popularity due to the increase in prices for petroleum products. An electric car is a vehicle, which is propelled by one or more electric motors, using energy stored in rechargeable batteries. The production and population of electric vehicles is growing. In the course of campaigning and advertising, many people think that electric cars are more environmentally friendly than cars with an internal combustion engine. But while these new vehicles don't directly produce any carbon emissions, are they really as good for the environment as we think? Much depends on whether the electricity used by the cars is produced by renewable sources or a coal-fired energy plant. There are also ecological question marks over the components used in electric cars, including the battery and the use of rare-earth metals.

It should be noted that EVs release a lot of CO2 during the manufacturing process. This is due largely to the production of lithium-ion batteries. It has been calculated an electric vehicle with a 100kWh battery emits 15-20 tons of carbon dioxide even before the vehicle ignition is turned on. It is approximately of 150 to 200 kilograms of carbon dioxide for each kilowatt-hour storage capacity in a car battery. A typical vehicle with an ICE only produces that much carbon dioxide after it has driven 100,000 km. What's more, the country in which batteries are manufactured as well as the materials used

has a great impact on the level of emissions produced. Also, its power reserve, charging time, battery life, battery replacement and, most importantly, disposal is considered. In fact, manufacturer's warranty the replacement of lithium-ion batteries for eight years or 100,000 miles, whichever comes first. However, there are still some problems with disposing of the electric vehicle batteries since the battery itself cannot just be thrown out. It's illegal to throw away any batteries with regular trash because their breaking down of landfills could pollute groundwater. Lithium-ion batteries are less toxic than lead acid ones, but they can still threaten people's health. And since there is no ideal way to recycle them today, they are simply sent to a landfill, where batteries begin to decompose, poisoning nature. Now, we must also take into account the production of electricity. Let's look at where the electricity comes from. Most of the primary electricity is generated by burning coal (47%), natural gas (21%), while a whole complex of combustion products is formed. The main one is carbon dioxide (CO_2). It turns out that all the same, there are emissions and not small only not from an electric vehicle, but from power plants that are the direct power supply of the vehicle themselves. And if we take into account electricity losses, the cost of coal, oil or gas, then we can conclude that electricity is not an environmentally friendly product, respectively, and the vehicle that run on it. There's no denying that more study is needed to understand the impact of EV battery production worldwide and more work is needed to develop methods that make it more sustainable for the environment. However, it is not entirely clear why some countries are trying to ban sales of vehicle with internal combustion engines as soon as possible. To achieve the maximum effect, it is necessary not only to transfer everyone to electric vehicles, but also to make the processes of their production and the production itself as environmentally friendly as possible.

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Karnitskiy D., Kashavarova Y., Slesarenok E.

Caterpillar Dump Trucks

Belarusian National Technical University
Minsk, Belarus

The development of mineral deposits is a significant proportion of the global economy. On our planet, rich useful resources, the producing industry refers to the main profitable business sectors. For the organization of work at mining facilities and careers requires special productive equipment. Off-road dump trucks with a roomy body are some of the most sought-after machines in the extractive industry.

The development of such a network as Caterpillar helps solve the problems of the technical equipment of large companies in the global market. The manufacturer pays special attention to the design of heavy equipment for the mining industry. CAT off-road dump trucks deservedly occupy leadership positions in the ratings of the biggest models in the world.

Industrial equipment Cat brand is difficult to attribute to budget, but it does not have equal in reliability, performance, carrying capacity and efficiency in operation. The necessary criteria for extreme mining conditions are fully reflected in the line of off-road dump trucks. They differ in high power and durability when performing work. The manufacturer offers multifunctional machines of different load capacity, with different engine power, which allows you to increase the efficiency of work and reduce costs, due to the number of material transported per ride. Caterpillar production does not stand still and is constantly developing, improving and expanding model ranges of dump trucks.

CAT 785D

Currently, the CAT ruler includes 13 basic models in the limit ranges of 36-363 tons, and the engine power is 483-4056 liters. The leading positions in the top of the largest and most popular Cat brand dump trucks takes the mountain model 785 D. Engine characteristics provide confident movement on off-road, including cool descents, Fully integrated AHS system. The mechanical power transmission CAT and the transmission with switching under load provide not having analogs of the efficiency and controllability on steep rise, in off-road conditions, as well as on roads with high rolling resistance.

The model is designed to organize mining work at an altitude of up to 4267 meters. Like all CAT dump trucks with a mechanical drive, the 785D model is equipped with the mass-loading brakes of four wheels and automatic control of the retarder for better control of the machine. The 785D career dump trucks is equipped with oil renewal systems, continuously filtering the rear axle oil, filters with an extended service life, and less frequently require maintenance. All this reduces the amount of waste entering the environment.

CAT 789D. The next place in the rating of dump trucks is the model with the technical mass of 324319 kg. Cat 789D career dump truck loading capacity reaches 181 tons. The machine is equipped with an industrial motor CAT 3516C HD. This SUV is capable of working in difficult conditions and on high mountain slopes. The advantage of this model in an efficient brake system that provides safe movement

The oil cooled brake system CAT has a high reliability and provides the handling of the machine even on the worst roads. The combined system includes a working, auxiliary and parking brake, as well as a retarder brake. In this case, the design of the system remains reliable in operation, which ensures maximum braking efficiency.

Convenient access to daily service points facilitates performance and reduces regular maintenance time. Convenience of maintenance and increased up to 500 hours of interclavicle intervals provide reduced machine downtime and increase its performance.

CAT 793D is supplied by a manufacturer in four options for the organization of mining at different heights. Like all CAT dump trucks with a mechanical drive, model 793D is equipped with oil-boring brakes of four wheels and automatic retarder control for better control of the machine, as well as faster and confident work.

The undercarriage of the quarry dump truck is designed to move up and down steep slopes with a loaded body. The 793F provides the industry's best payload at rated gross operating weight. The 793F climbs a 10% slope with a best-in-class speed of 12.9 km/h. The 20% increased torque of the C175-16 allows you to develop a large tractive effort during acceleration to overcome steep climbs and off-road terrain.

Mining processes depend on the development of the production of large-sized industrial machines of high capacity. Quarry dump trucks that can work in extreme conditions greatly simplify the transportation of rocks from deposits. But as a rule, the use of large-sized special equipment of large sizes requires significant costs for the maintenance of a commercial fleet and the training of operators.

If you are considering buying a Cat dump truck, you should objectively evaluate the profitability of the solution. When choosing equipment, you need to take into account the amount of mining or quarrying work. It is necessary to take into account the downtime of large-capacity commercial vehicles, as this will be unprofitable for the company. Large Cat dump trucks are advisable to purchase for the organization of permanent work in the mining industry.

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Khodosovskaya Y., Kyrinnaya D., Slesarenok E.

Unmanned Aerial Vehicles in Transporting of Consumer Goods and Medicine

Belarusian National Technical University
Minsk, Belarus

According to experts from the World Bank, the development of drone technology and advanced control systems is one of the main drivers of logistics development. Drones are used not only for filming movies, news stories in hot spots and travel shows, in the work of archaeologists and geologists, in the field of agriculture, to find bombs, rescue people and repair bulky vehicles. Drones are an integral part of the future of the delivery industry.

The idea of using unmanned aerial vehicles (UAVs) to deliver cargo has been around for a long time and, despite certain administrative barriers, is finding favour with many corporations all over the world.

One of the first companies to test new pizza delivery technology by drone was Domino's Pizza, whose first launch took place in Australia.

In December 2016, Amazon, the largest online retailer, conducted its first test delivery using Amazon Prime Air. To date, it is the only company using drones so extensively in the delivery business.

In 2014, Alphabet Corporation's innovation arm announced its drone delivery project called Wings. Its goal was to develop an automated UAV and the infrastructure to use it not only for itself, but also for other companies. The project demonstrated several types of drones built with different aerodynamic designs. However, in 2016, it was reported that

the project was frozen, the main reason being administrative restrictions on the commercial transport of UAV cargoes.

DHL is one of the largest logistics companies in the world that has shown interest in using UAVs for deliveries. The company conducted its first tests using UAVs back in 2013, for which it received official permission from aviation authorities, and the flight area was closed to civil aviation.

The Dutch technical university TU Delft has launched a sophisticated project that aims to provide first aid to people in cardiac arrest. For instance, the drone can save a life with the help of a built-in defibrillator. It is also able to accelerate up to 100 km/h, which significantly increases the arrival time.

In 2016, the Californian company Zipline agreed with the government of the African state of Rwanda to deliver blood donations and medicines using UAVs. One logistics centre is capable of serving clinics within a 70-km radius. The project is operating quite productively and there are several broad plans to use it in Tanzania and the USA [1].

Also worth noting is Matternet, which first used UAVs in 2012 to deliver medical supplies to a refugee camp in Haiti. In 2016, the company participated in a project to deliver HIV/AIDS blood samples to populations in remote villages in the Republic of Malawi. Matternet is currently working with Mercedes-Benz to develop a new type of cargo van, the Vision Van, which can be described as an 'aircraft carrier'. This minibus is equipped with a cargo compartment and drones for cargo delivery. The fact that this is just a concept vehicle aside, its unlikely we'll see the Vision Van hit the road anytime soon.

Moreover, drones are used not only in cargo delivery, but also in warehousing logistics. A prime example is the L'Oreal Company, which uses drones to collect data on all the goods that are in their warehouse in a matter of hours.

It is worth highlighting the advantages and disadvantages of UAVs for cargo transportation.

So, the benefits include:

1. Cost savings. The co-founder of Kiva Systems, a drone development company, estimated the cost of delivering a load of no more than 2kg by drone "last mile": it is $0.1. In comparison, ground delivery of a cargo of similar parameters ranges from $2 to $8. What follows from the savings is a big profit, even with a huge investment. Companies will reach out to each other, using UAV technology to respond to the demand created by fast delivery of goods.

2. Eliminating the "human factor". An example is the military, which has been using drones for a long time and on a regular basis. Therefore, the emergence of unmanned cargo aircraft is a reality. Such vehicles will not need expensive life support systems. Also, drones could be safer, given that most aircraft accidents are caused by 'human error'. Automation of production and logistics chains is the main purpose of drones.

3. Environmental friendliness. Electricity is the only resource necessary for drones to function, unlike vehicles, which are highly polluting. The US government has long lobbied for 'green manufacturing', encouraging this development by imposing high taxes on industrial waste. In contrast, the use of drones is completely environmentally friendly and can be toxic to humans.

4. Flexibility in the supply chain. The autonomy of drones allows for course corrections in case of necessity, force majeure or certain customer requirements due to the high speed of response to changes in order conditions.

The disadvantages of using UAVs include:

1. Privacy and security. UAVs are a major threat to the information security not only of citizens, but also of companies, as their flight altitude is quite high and in fact the law does not encourage the expansion or dissemination of one of the most efficient and environmentally friendly types of logistics process optimization and cost reduction.

2. Bills. There are a number of draft laws that strictly restrict the flight of drones in airspace. Registration of these vehicles at state level is also required, and this procedure is also necessary for drones owned by people who use them not only for commercial purposes, but also for entertainment. However, there is a limit to the technical characteristics of the vehicle that exempts it from the need for registration. Nevertheless, in most countries legislation is the main limitation when deploying logistics processes using drones.

3. Problems during traffic. So far, there are several examples of drones being unsafe for nature. For example, birds can get caught in the blades of drones, resulting in the death of a bird, as well as damage to the machine itself.

4. Risks. UAVs are subject to certain risks due to theft, shooting at them, etc. The main problem with this is that the drone's location can only be determined from its last position because of blind spots if a camera is used.

5. Collision with nature. Changes in weather conditions entail changes in the timing and speed of the drone's flight. It is necessary to predict the days of possible deliveries if the country's climate is variable [2].

In conclusion, the use of UAVs will develop not only in the transport of goods, but also in logistics in general. This technology will become one of the most in-demand in the near future due to its high delivery speed, long-term savings, automation of logistics processes and, what is more, will be more environmentally friendly.

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Labusova A., Slesarenok E.

Professional Development of Logistician

Belarusian National Technical University
Minsk, Belarus

In the modern world, with the new market structure, manufacturers are mainly focused on the consumer. This can be easily replaced by the rapidly growing number of additional services that manufacturers and firms offer. For each consumer in the new conditions, it is important not only to get the highest quality of the product or the performance of the service, but also to get as many additional services as possible at a minimum cost. And the cost depends, in turn, on the costs that are associated with various works and operations.

Reducing the cost of delivering a product or service from the manufacturer to the consumer can be achieved by applying the principles of logistics in the activities of organizations.

Logistics activities are integrated in nature. It can be observed from the moment the need for a service or product arises until this need is met. Logistics can be considered as the result of the joint activities of various companies to connect the processes that are associated with the achievement of the goal of their enterprise [1].

Logistics management in the company performs the functions of organization, planning, regulation, coordination, control and analysis. One of the most important tasks of logistics management in the company is to coordinate logistics functions and coordinate goals with suppliers, contractors and consumers.

The joint logistics system of enterprises is based on such important areas as the purchase of raw materials, production,

sales, material flows, transport, information, finance, as well as inventory management, quality management, material demand planning, etc.

There is a tendency to increase the level of requirements imposed by consumers to the quality of service. With the development of market relations, consumers get more and more opportunities to compare and choose the best service.

The key to the success of the enterprise depends not only on itself, but also on all partners of suppliers, dealers, distributors, carriers, freight forwarders, etc. This requires ensuring free access and interconnection with all tasks, functions and processes, as well as an integrated and integrated approach based on logistics principles [2].

In the modern world, logistics and supply chain management play an important role in the economic activities of both countries in general and companies in particular. Thus, the total turnover in the logistics market in the leading industrial countries annually amounts to about 1.5 trillion rubles. euro. According to experts, in the short term, annual turnover growth in the logistics market is expected in the region of 5-10 % worldwide, while in countries with emerging economies, such as China and India, the growth rate is significantly higher than the average level.

The demand for well-trained employees in the field of logistics significantly exceeds the supply. The lack of employees in the field of logistics in the world is mainly due to the high level of professional requirements for training specialists, which is due to the large complex of problems they solve.

A professional in logistics is expected not only to have practical skills and experience in solving logistics problems, but also to have a systematic knowledge in the field of mathematical modeling and statistical analysis, an

understanding of business processes in the enterprise and knowledge of management techniques.

In addition, personal qualities, decision-making skills, responsibility and the ability to delegate authority, customer communication and negotiation skills, and a willingness to learn and innovate in business are important for success in logistics and supply chain management.

In the context of growing interdependence and the high dynamics of the changing world of competition, more and more companies go beyond the boundaries of their activities only within their own country, which requires their staff to gain new knowledge and understanding of international specifics, the ability to work in an environment of cross-cultural interaction, to understand international transport and customs regulations.

Therefore, for logisticians, English is the most important criterion in order to survive in the harsh competition in the international arena. Companies that do not speak English significantly limit their growth opportunities and may lose out to their competitors who have adopted it.

Moreover, the English language helps to unite employees of companies from different countries in solving common tasks, because in business correspondence, negotiations, and the conclusion of large transactions, companies prefer English as the working language [3].

Mastering English at a professional level, suitable for communication at the level of narrow specialists, has always been a difficult task. This is largely relevant for the communication of logisticians.

The long-term practice of developing communications between logisticians from different countries in English has led to the emergence of a wide layer of special terms and slang, and the peculiarities of the style of international communication.

It can be noted that a Russian-speaking specialist, even if he is fluent in English at the everyday level, will hardly be able to understand the professional speech of a foreign logistician. To this end, and taking into account the active integration of companies into cross-border logistics cooperation, it is important to train logistics specialists in advanced communication skills in English, taking into account the industry specifics.

From the above, we can conclude: realizing the huge contribution of logistics to increasing the profitability of business processes, business owners often have to turn to experts in the field of logistics. This indicates good prospects for the development of logistics in our country.

In recent years, the construction of high-tech full-cycle warehouse complexes has been actively growing, programs for automation and optimization of logistics processes are being issued, and high-quality training in the field of logistics is required to ensure functional work.

It is necessary to quickly introduce logistics thinking and intensive training in the practice of managers and staff of various enterprises, etc., as well as to improve the level of English language proficiency and confident use in the professional activities of a logistician.

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Lavyshik I., Buryak I., Slesarenok E.

Matrix Headlights

Belarusian National Technical University
Minsk, Belarus

Matrix headlights are high-tech developments, thanks to which the motorist began to feel more comfortable and safer when driving in the dark. Unlike standard optics, matrix headlights provide a sophisticated LED system, controllers and intelligent modules. Matrix optics automatically adjusts the brightness and illumination of zones depending on the traffic situation. The driver no longer needs to think about switching between light modes, as the built-in intelligent system is involved. It has such functions as: changing the direction of the light flux, recognizing and illuminating pedestrians, road signs. When vehicles are detected, the system automatically turns off those LEDs which light flows from the maximum to the car. When people or animals are detected, the headlights automatically flash three times in high beam mode. When a sign is detected, the beam of light focuses on it. This increases the attention of both the driver and pedestrian. Advantages over other types of headlights are: a) overall dimensions - halogen and gas-discharge optics require a large mounting space, and LEDs are easy to install even on a small board; b) service life - the system consists of a minimum set of elements susceptible to malfunctions and failure; c) lighting brightness - the indicator is regulated by the characteristics of the LEDs; d) lighting control - using sensors and vehicle recognition systems, objects are automatically analyzed and lighting modes are changed. The matrix completely switches off the adaptive high beam at speeds below 60 km/h. It changes the beam of

light depending on weather conditions. In fog, the headlight shines down under the bumper and to the side. In the city, the beam narrows, but on the suburban highway, on the contrary, it widens and crawls out to the side of the road. If the camera sees a person walking, then one of the modules directs a bright beam at the pedestrian and illuminates him in the dark. This helps a lot when traveling past villages. The possibilities of matrix LED headlights are endless. The design of this type of headlight consists of separate modules - high beam, low beam, direction indicators, overall dimensions. All this is arranged in a single block, the shape of which depends on the vehicle design and design solutions. Each module uses a group of LEDs. For example, in the high beam section, there may be 25 of them, grouped by 5 pieces. Each group has its own reflector and radiator for cooling. Among the disadvantages of optics, only the high cost and use of technology in premium cars can be distinguished. Matrix laser headlights are used in the latest Audi models. In this design, the light is a laser. Its beam, passing through a special lens coated with a special fluorescent compound, acquires white light and becomes safe for the eyes. The matrix laser headlight can selectively create shadow zones, for example, for oncoming cars. Moreover, it can regulate the beam propagation. For example, when driving on a highway at high speed, the beam becomes narrower, the light is concentrated in a narrower beam, shines farther and brighter. When moving slowly the beam expands to cover most of the surrounding area. Matrix headlights make driving on the road much easier, especially in bad weather conditions or at night. The driver does not need to switch light modes, but to turn [1].

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Prokopovich V., Tratsevskaya A., Slesarenok E.
BTLC State Enterprise

Belarusian National Technical University
Minsk, Belarus

Belarusian railways are the most effective, the most reliable and the most popular means of transport, which has the required infrastructure, sufficient carriage and traffic capacity reserves of railroad hauls and stations. The Belarusian Railway is a part of the international railroad network of the II and IX Pan – European transport corridors used for main freight transportations between countries of Europe and Asia.

The development of freight transportation for Belarusian Railway is predetermined by the following factors: 1) economically advantageous location, at the junction of 1435 mm and 1520 gage lines being a link between Europe and Asia; 2) considerable capacity; 3) efficient implementation of technical, commercial and border operations; 4) competitive rate management conditions and flexible rate management policy.

In order to ensure freight transportations, the Belarusian Railway has 228 stations that carry out freight handling operations, 6 companies involved in terminal freight handling, 50 freight terminals situated in regional centers and big cities of the republic and equipped with necessary mechanical aids and storage spaces, and about 90 freight offices, including 37 linear transport service centers, where more than 5.3 thousand persons are employed.

Terminal and warehouse infrastructure of the Belarusian Railway amounts to over 604 thousand square meters of storage spaces. Available unsheltered and sheltered warehouses

of temporary storage, customs warehouses offer a possibility to accumulate and store freight, and also to split or consolidate lots, carry out freight marking and package batching.

The Belarusian Railway has the necessary infrastructure for arrangement of the work of transshipment of freight from cars of 1520 mm gauge cars into 1435 mm gauge cars and back at terminal complexes situated at the Belarusian – Polish border. BTLC State Enterprise is able to implement multimodal transportation involving marine and automobile carriers, as well as to organize the handling of cargoes in all ports all over the world. Development of transportation by container trains is one of the top priorities of the enterprise. BTLC State Enterprise offers the delivery of goods, which require special transportation conditions. When organizing transportation takes into account all the nuances and this fact provides excellent result. Due to the powerful refrigerating equipment and reliable thermal insulation provides stable maintenance of goods temperature regime down to -20°C. BTLC provides refrigeration rolling stock for perishable goods at any distance. BTLC State Enterprise organizes the whole transportation process at the level of international standards, optimizing the time and cost of cargoes delivery to customers. BTLC State Enterprise provides own, attracted and leased rolling stock for cargo transportation. Thanks to the cooperation with the major operating companies, the enterprise performs the backhaul loading in the CIS and the Baltic States. The work of employees allows a more efficient use of rolling stock and reduce transportation costs for cargo owners. BTLC State Enterprise is hooking up of containers with Belarusian export cargoes at the stations of the Belarusian Railway by the appointment to China in route Europe-Chine. It is developed to create conditions and provide a comprehensive service for export of Belarusian companies' products to China by rail.

The structure of BTLC State Enterprise includes services of transportation and logistics outsourcing. A customer may use terminal services at freight stations of the Republic of Belarus. One of the most important terminals is Kolyadichy, where you can get: 1) loading and unloading operations with large-capacity containers and heavy cargoes (weight of one place up to 55 tons); 2) loading and unloading operations in covered wagons and vehicles; 3) loading and securing of automotive vehicles and oversized cargo; 4) organization of combined transport using own container truck park; 5) safe storage at warehouses and outdoor open container area, including customs control regime; 6) customs clearance of containers with cargo.

Terminal Stepyanka also has a key role in the logistics of Belarus and helps in: 1) loading and unloading operations with heavy cargoes; 2) unloading of bulk cargo and loading on trucks; 3) loading and unloading operations in covered wagons and vehicles; 4) organization of combined transport using own container truck park; 5) safe storage at warehouses and outdoor open container area, including customs control; 6) customs clearance of containers with cargo.

The Belarusian Railway plans to implement measures aimed at pursuing a flexible tariff policy to ensure the competitiveness of freight transportation by rail, improving the conditions for organizing international rail transport, further developing transit rail transport, developing and implementing new technologies related to accelerating the passage of container trains [1].

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Radziuk A., Kalashnikova M., Slesarenok E.

Transportation of Exotic Animals

Belarusian National Technical University
Minsk, Belarus

Nowadays, not all logistics companies are engaged in transportation of animals, and even more exotic. Since such shipments require great effort and must be calculated to the smallest detail. This article discusses the transportation of basic animal classes. To ensure the most proper transportation of exotic animals, you should pay attention to some important points. They may differ depending on the type of animal. Requirements for the transport of exotic animals are quite large, as they require the availability of resolution and procedures. To carry out transportation, in addition to the veterinary inspection, it will require the availability of standard allowing documents and procedures, namely: certificates F1; veterinary passport of the animal; procedures for chipping for travel abroad; vaccinations from rabies or carrying out the prevention of various diseases, depending on the region of the following region. Another important point that should be considered when transporting is the requirements for containers: containers must be closed; The container must correspond to the gabarites of the animal; Containers must be clean, dry, have the required amount of ventilation holes; Containers should be a place to accommodate special designations and marking. For transportation, the listed animals will be used a car-van with an isothermal body adjustable temperature and ventilation system [1].

When transporting birds, it is important that they are in the dark, warm and well-ventilated portable box. The portable

box should be optimal for the size of the bird, but so that it cannot fly. This is necessary in order to exclude self-removing during transportation. A reliable spacious cell is needed into which the rider and a strong jergin is installed. For security purposes, minor feathered breeds can be transported in cardboard boxes, with holes for air circulation. During the transportation of the bird, it is necessary to maintain a temperature regime within 24-26 ° C. It is recommended to use climate control, since drafts can lead to the hypother of the bird. The bottom of the carrying should be covered with a cloth so that the bird does not slide on the smooth bottom during the movement and could cling to claws. It is also necessary to wrap the carriage outside the dark cloth. It is necessary to make sure that the ventilation openings will be open at the same time. Cells, boxes and containers are allowed to ship to vehicle tiers (no more than four), having them so as to provide in each cell (drawer, container) free air circulation.

Transportation of rodents and haresay should be carried out in individual carrying. If this carrying is made of a rigid structure, then it is necessary to put soft cotton products to it, so that the animal is not injured during the movement. Conventional cells are suitable for transportation in the warm season, and in the cold period, the animal can perch up. In a warm period of time, a light fabric can be put on the bottom of the container, and in the winter it is necessary to put the heating pad. The temperature should be maintained 20-24 ° C and relative humidity of 45-65%. The exception is the gerbil, when transporting which the relative humidity is 35-55%.

Transportation of reptiles, such as snakes, iguana and chameleons, are optimally produced in dense tissue (cotton, delicate) bags or bags. The carriage in plastic containers with ventilation holes is also allowed. This is the optimal means to move them at distances. When transporting snakes and iguan, a temperature of 27-30 ° C must be maintained and 80-95%

should be achieved. When transporting chameleons, the temperature regime should be 26-28 ° C, and the humidity ¾ 20-55%. Turtles, even aquatic, transported without water, with the exception of some species, such as trionix, which is best to cover with a wet towel. Tritons are necessary when transporting the presence of a small amount of water, like frogs that cannot be long without it. The temperature mark during transportation should not be descended below + 18 ° C [2].

Transportation of snakes is carried out according to the rules of increased safety in closed containers, indicating the labeling about the types and number of pets. The best option for temporary packaging will serve as a "penalty" structure and the densest bags. Any transporting cargo must have strong locks and allow the snakes to get oxygen through a small grid. For convenient carrying, it is better to choose containers with durable handles. On the bottom of the box for better thermal insulation it is worth postpone the foam, sawdust or sliced paper. When transporting in winter, use additional heat and choose the types of transport, allowing to reduce the time of staying along the way to avoid. When transporting exotic animals, a logistics company must think in detail each stage of transportation. From the correctness of the selection of the vehicle and the transportation container will depend on the quality of transportation and safety of animals. When performing each condition of transport, the load / animals will be delivered on time in integrity. –

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Reznichenko V., Slesarenok E.

Can Solid Oxide Fuel Cells Change Transportation?

Belarusian National Technical University
Minsk, Belarus

Fuel cells have been under development for more than 180 years since its discovery in the early nineteenth century. Several types of fuel cells have resulted from extensive research and development work, but only two types have reached a stage of commercialization.

One is the polymer electrolyte membrane fuel cell (PEMFC) and the other is the solid oxide fuel cell (SOFC). It is a generally accepted opinion that the former is better applicable for transportation and the latter for stationary power applications.

As our energy demands grow, so does our dependence on fossil fuels. However, the fear of depleting resources and an increased dependence on foreign oil has thrown the spotlight on alternative energy sources, such as fuel cells. Instead of burning fuel, they work by generating electricity through a chemical reaction.

A fuel cell uses a positive electrode (the cathode) and a negative electrode (the anode) with an electrolyte in between for conducting charged particles. Scientists have known about fuel cells for more than a century, and NASA actually used them in the 1960s on the Apollo spacecraft, and then later on the Space Shuttle [1].

One of the most efficient types of fuel cells is the solid oxide fuel cell (SOFC). In an SOFC, oxygen is sent through the cathode, releasing negatively charged oxygen ions that pass through the electrolyte from the cathode to the anode. At the

anode, the ions encounter a fuel gas and react, releasing electrons (as well as water, carbon dioxide and heat). This creates a current of usable electricity. Multiple fuel cells are put together in a series known as a stack.

Not only do SOFCs produce fewer emissions, they're also about two to three times more efficient than internal combustion methods. One advantage that SOFCs have over hydrogen fuel cells is fuel flexibility - SOFCs can run on a variety of fuels, including hydrogen and biofuels. They also use cheaper ceramic material rather than precious metals, unlike other fuel cells. They also don't rely on reusing wasted heat (called combined heat and power schemes). Because of these numerous advantages, SOFCs have already proved useful for heating buildings.

However, numerous constraints have limited their applicability on a wide scale in things like cars. Namely, the SOFCs are very big and very hot. The high temperature allows for higher efficiencies, but it also poses engineering problems. Typical SOFCs that have been on the market, such as the Bloom Energy Server (known as the Bloom Box), use thick electrolytes in the fuel cells to add structural support. But this causes more electrical resistance that needs to be overcome by high temperatures.

In 2011, however, researchers at the University of Maryland announced developments using a new design and different materials for the electrolyte that allow for a much smaller size. The researchers also successfully reduced the operating temperature significantly to 650 degrees Celsius (1202 degrees Fahrenheit), down from 900 degrees Celsius (1652 degrees Fahrenheit). This lowers the costs of the insulating materials, which are necessary for reducing the time the system needs to heat up.

Although hydrogen fuel cells have gained a lot of media attention as the future of alternative energy cars, many believe

that SOFCs actually hold the most potential for transportation. For instance, even as developments continue to make SOFCs more practical for use in vehicles, we could see cars that combine the electric car battery with SOFC technology.

Description of the various types of SOFCs: solid oxide fuel cells can be mainly grouped into tubular and planar designs. Both types can consist of one or several single cells per stacking unit, i.e., on a single tube or in a single multilayer. Depending on the application, tubular SOFCs have dimensions from needle-like to lengths of about 1.5–2 m for rapid start-up times and large gross power, respectively. On the other hand, the planar is the most common SOFC design thanks to its higher performance [2].

This architecture can lead to two different stacks containing metallic or ceramic interconnect material as well as with cells with thick (electrolyte-supported, 1st generation cells) or thin (electrode-supported, 2nd generation cells) membranes with thicknesses usually of 150–250 μm and 5–20 μm, respectively. The size of technologically relevant planar cells varies from 10 × 10 cm2 to 25 × 25 cm2 or corresponding areas in round or rectangular shape.

The today general tendency of reducing the operating temperature from about 1000°C to 500–800°C favors cell designs with thin electrolytes, lower ohmic resistance and, therefore, higher power density, passing from the 1st to the 2nd generation of cells. For this reason, many developers have considered electrode-supported cells the best choice for realizing SOFCs operating at reduced temperature.

During recent years, more interest is devoted to the 3rd generation SOFCs in which the mechanical strength is given by the electrode side, though not necessarily by the electrode substrate. In all these cases, the substrate is always porous to allow gas transport to and from the anode. The materials used

for such substrates are metals or alloys, or even refractory ceramics.

In the case of insulating substrates, they only deliver the fuel gas to the anode and the current path has to be established along the substrate surface instead of passing perpendicular to the substrate surface as in electrically conductive substrates. In the case of metallic substrates, the thermomechanical compatibility is one of the main issues to be faced, because they often have higher thermal expansion coefficients than the other cell components.

Ferritic stainless steel is one of the most considered materials thanks to a coefficient of expansion similar to the ones of the cell ceramic materials (YSZ, GDC, electrolyte, or anode functional layer). Furthermore, its lower cost in comparison to either YSZ or GDC, cathodic and anodic materials lead to an overall reduction of the cost of the device.

The layers typically have thicknesses of 5–20 μm for the functional anode, 10–20 μm for the electrolyte, and 50–80 μm for the cathode. Also, the cathode is nowadays composed of two layers: an electrochemically fine-grained composite of the electrolyte material and the electrocatalyst and a coarse current collection layer supplying air and electrons to the composite layer.

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Semashko E., Slesarenok E.

Lean Production: How to Achieve

Belarusian National Technical University
Minsk, Belarus

When we talk about the term *lean production*, many people think that it is the fact that a company produces something while already thinking about how much it can sell by producing just that amount. In fact, this is not the case. Lean production is the act of producing so that there is no waste, or even with the least possible waste.

At first glance, the lean is a savings. In fact, lean production does not work to minimize costs, which can lead to a decrease in product quality, but to reduce the losses that exist in every workplace, regardless of the type of activity.

The main creator of *Lean production* is Taiichi Ono, who introduced this concept in the 50s of the last century in the Japanese company Toyota Motor Corporation [1].

According to Professor Peter Hines, consultant at SA Partners (UK), lean production helps to survive in the long term, when a company faces new competition and changes in macroeconomic conditions, making it more flexible and adaptable to changes. This concept allows a company to thrive with the same resources, often doubling its output.

The concept of lean production is now widely used not only in the automotive industry, but also in trade, services, utilities, health, education, the armed forces, the public administration sector and many other activities.

Keeping in mind that lean production is aimed at making the most possible use of minimal resources and avoiding

losses, we will pay attention to some of the tools among several that are part of the Toyota production system. They include:

Just in time. One of the main tools of the Toyota production system is the method of organizing production. This tool means that during the production process, the necessary parts are on the production line exactly at the time when it is needed, and in exactly the right quantity. As a result, the company consistently eliminates downtime, minimizes inventory, or can reduce it to zero. The main characteristics are the availability of only the necessary stock when necessary; improving quality to the state of «zero defects»; reduce cycle time by reducing equipment uptime, queue size, and production batch size; gradually improve both operations and their implementation with minimal cost.

5S program. A tool of the lean production system that can improve the production process, reduce losses, organize jobs, and thereby increase the productivity of the enterprise as a whole. It involves organizing each workplace using visual cues to achieve optimal performance. It is one of the fundamental tools of lean production. This method includes five main strategies: *sort; set in order; shine; standardize; sustain* [2].

The goal of 5S is to make the workplace more functional and more comfortable. This is done by placing tools and materials in logical places depending on who needs them, how often they are needed, and so on. Spaces are cleaned regularly. Cleaning and organization become habits. When used correctly, 5S ultimately makes processes safer, efficient, and more stable.

Kaizen: a lean production system tool that can improve the production process, reduce losses, organize jobs, and increase the productivity of the enterprise as much as possible .

The idea of the Kaizen concept is to continuously improve all organizational functions from production to

management. Kaizen is the basis of the concept of total quality management (TQM). The main goal of Kaizen is to change for the better by implementing various measures to reduce the level of losses in the organization. The essence of kaizen is the synergistic effect of combining the efforts of employees. Kaizen suggests that there is no enterprise without problems. Kaizen helps solve these problems by developing a work culture where each employee is not penalized for the problem, but ensures that it will not happen.

Kanban is a production process management method within the lean production concept that uses information cards to transfer a product order between processes. This tool provides an indication of production or product transition from one process to the next. The Kanban system is a way to optimize the production chain, starting from the first stages of forecasting demand for goods and ending with the distribution of tasks between production facilities. This technology, in turn, is aimed at optimizing the size of inventory and ensuring a high level of order fulfillment on time.

Andon is a multi-colored signal lamps (Andon-traffic lights), a Board or a digital display Board that use special messages to show specialists the location of the problem.

You can look at the operation of the system on the example of the Toyota concern plants. Each production site is equipped with a special cord for signaling. When a fault occurs, the worker pulls it, and the large display lights up yellow, which indicates that a defect has been detected in a certain area. The screen lights up in red, indicating that work on this section is suspended and the problem is being fixed. The main task is to achieve quality improvement, even at the cost of temporarily suspending some processes.

This allows you to respond to the problem in the shortest possible time. The foreman should not spend his time constantly monitoring production. The advantages are that you

can directly control the production, and the worker can help with a simple movement of the hand, so that the fault can immediately be analyzed on the spot and eliminated. Using the Andon, a worker can also indicate that they are, for example, overloaded and need help, or that there are security problems.

Andon indicates: the current state of the process on the machine, the occurrence of a malfunction (for example, lack of materials), actions (for example, setting up, cleaning the machine), and so on.

As a result of the implementation of the system of visual notification of emerging problems, companies achieve impressive results that are not available in many organizations that do not use Andon. Effective use of the Andon system is possible only if it becomes part of the philosophy of the company or organization as a whole.

The most important goals and objectives that the Toyota production system and lean production in general follow are to value each customer; to reduce delivery times, and to achieve the complete elimination of all types of waste [3].

Thus, lean production can improve the quality of goods and services provided, increase labor productivity and employee motivation, which in turn affects the growth of the company's competitiveness. This concept is still very young, but it is constantly being improved. The success of lean production is obvious, so its ideas are popular all over the world.

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Vasiukova A, Alenskaya A, Slesarenok E.

Most In-demand Skills for Working in Logistics

Belarusian National Technical University
Minsk, Belarus

It is common knowledge that when applying for a job, employers pay great attention to your personal characteristics. Ability to cope with stress, creativity, logical thinking and other skills are in great demand. Every year big companies tend to hire the most professional specialists. So, a good logistician should possess a big list of skills to enter into the next phase of your career.

At first worth to be considering is the psychological side. People who work with the organization of transport are subjected to moral exhaustion and nervous breakdown. Logisticians need to be able to handle stress and high-intensity environments, as this business is full of unexpected changes. Working conditions influence the success of the teamwork, satisfaction with the process and results of the work. The nature of relationship in the group has the great importance. Work in logistic sphere requires interactions with colleagues because it is too difficult to one person to deal with all the tasks. Therefore, one of the soft skills is teamwork. At the start of your career, it will be useful to train skills in teamwork.

We can state that planning your working day has a great importance because it always makes you focused on your professional task. Knowing how to properly assign your duty improves execution speed and completion success rate. Keep in mind that some issues can be resolved last, and some are of primary importance.

However, many tasks in logistics claim to find the most optimal solution. For example, a logistician should to pave the way with a special washing station for a car with a container from harmful cargoes to complete multiple tasks with a single trip. It is essential for a logistician to have such a skill as logical thinking. It is necessary to form the simplest, but at the same time the safest and least costly routes for the passage of one car or a whole block. Beginners very often start to panic when unexpected problems appear. Nevertheless, in no case should this be done. You need to solve such problems with your head. Working in the logistics sphere requires to stay in touch day and night because the work of many drivers and a successful delivery of cargoes depend on a logistician. So many logisticians aren't able to work in a stressful environment at the beginning of the career. With an experience in the logistics sphere, the ability to cope with stress increases.

Regardless of whether you work with drivers or with clients, you will have to communicate in any case. Communication is one of the most important skills in the logistics industry. Social skills will influence on: the number of active orders, authority in the company. A good speech is one of the priority indicators for the starting salary and a potential boss's disposition towards a logistician. Calling to clients is one of the most relevant requirements. The number of orders depends on the number of calls, and therefore the number of regular customers. On average, for 12 calls, only one client will offer you an order. On the other hand, if you improve your communication skills, the number of orders will triple, as customers will be emotionally disposed towards you.

The next part of article is devoted to the most crucial hard skills in logistic sphere: foreign language proficiency, computer skills and knowledge of the market.

Much attention is given to knowing at least one foreign language. Knowledge of a foreign language is one of the hard

skills. Working with foreign countries (Europe, Asia), English is the most important skill that must be developed at the highest level. Almost all countries know English at least at a basic level. Therefore, English language helps you to cope with language barrier.

Currently, there has been a considerable introduction of new technologies. Older devices are replaced with newer ones. The modernization also did not bypass the logistics side. Possession of a computer and some computer programs is one of the most important skills. Tracking cars, sending necessary documents, calculating the cost of transportation are carried out using special programs. Many companies require at least advanced knowledge of Microsoft Office programs.

Logistics is reaching an ever higher level, which means rising emergency of competitors. Every company wants to maximize the number of orders, customers, and profit and have a good reputation. To stay "afloat" it is necessary to analyze the market. This should be done in order to understand what the cost of transportation should be offered to the client in order to go with your company. Of course, reliability is an important factor. If a client has been working with you for a long time and is satisfied with everything, then he will most likely choose your company. But if the cost of transportation in your company is twice as much as in others, also with a good reputation, then his choice will depend on the price.

So, we can conclude that a perfect logistician should possess special skills: teamwork; planning; logical thinking; ability to cope with stress; communication skills and etc.

Except all these soft skills a good logistician should be good at one of foreign languages to communicate with clients from other countries. Also modern logistician tasks involve modern technologies. So a good logistician should be able to work with different computer programs. Stay strong and develop yourself – this is a slogan of a good worker.

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Yanch E., Chebotarenko M., Slesarenok E.

Quarry Dump Trucks

Belarusian National Technical University
Minsk, Belarus

Today, transport plays an important role in our life. Many things and processes today are simply unimaginable without transport. From an economic point of view, transport is an integral part of any production, operation of enterprises, and also serves to deliver all types of raw materials, fuels and products from points of production to points of consumption. But transport brings a lot of problems, one of which is environmental pollution. With the increase in the number of cars over the past 50 years, more harmful substances have been released into the atmosphere than have not been released in several hundred years. As for large trucks and other large vehicles and vehicles, they pollute the environment much more. Off-road vehicles are no exception and also have a detrimental effect on the environment. Dump trucks, due to their power and size, as well as due to operating modes, account for the largest share of off-road emissions. Moving ore in quarries accounts for over 70% of the fuel consumed. As the scale of mining operations grows, the role of haul trucks is constantly growing. In particular, the number of mining trucks in operation in the world is constantly growing. Thus, the largest supplier of mining equipment BELAZ annually sells about 800 dump trucks in Russia alone, and this number is constantly growing. But apart from Russia, BELAZ supplies its products to other countries.

One of the most popular and large quarry dump trucks in the world is considered to be the Japanese Komatsu. The

Komatsu HD 605-7 model has gained wide popularity all over the world. This model has a six cylinder four-stroke turbocharged, air – to – air after – cooled engine with water – cooled. Komatsu SAA6D170E – 5 engine provides 533 kW 715 HP (Net). With a Common Rail Injection (CRI) system, the engine is capable of delivering high power while still consuming fuel to a minimum, thus improving the speed of the engine. Large amounts of torque at low engine speeds give good acceleration with low fuel consumption and help improve performance. Harmony with Environment is provided by: low operation noise, lead-free radiator, brake cooling oil recovery tank. But whatever technologies have been introduced to reduce the emissions of all the usual internal combustion engines, the electric engine is much more environmentally friendly [1]. Dump truck manufacturer Komatsu has seriously considered improving the environment and saving money on fuel by converting its mining truck to an all-electric one. eDumper – this is the name given to this electric "monster" weighing 45 tons and the ability to lift more than 60 tons at the same time. An interesting feature of the eDumper is that it basically does not need to be recharged. This phenomenon is possible thanks to the innovative regenerative braking system. Regenerative braking is a type of electric braking, as a result of which, during braking, part of the energy generated by electric motors operating in generator mode is returned to the electrical network. When the eDumper moves uphill, it loses some of its charge, but during the descent downhill, it generates more electricity than it spent on the ascent. Thus, thanks to new technologies, this electric giant is able to produce more electricity than it spends. eDumper is based on the well-known Komatsu HD 605-7 dump truck. The maximum speed of the dump truck with such dimensions reaches 70 km/h. This dump truck is driven by an electric motor, namely a battery, the capacity of which is about 600 kWh, and the weight is

approximately 5 tons. What would you understand, the Tesla Model S long-range battery weighs 6.5 times less. Thanks to regenerative braking, the eDumper can produce about two hundred kWh of excess energy daily, which is equivalent to 75 megawatt hours per year. A similar dump truck without an electric motor consumes 10,000 to 20,000 gallons of diesel fuel annually. This means that up to 196 metric tons of carbon dioxide is saved every year! Also, the rejection of diesel fuel towards the use of electricity will save from 45,000 to 50,000 tons of diesel fuel per year. But soon the eDumper mining dump truck may not be the only electric dump truck in the world. By the end of 2021, tests of the new type of fuel cells will begin. Thus, the largest electric dump truck in the world can become a hybrid model from South Africa, capable of working not only on electricity, but also on hydrogen. The British company Anglo American has already begun to develop this, indeed, a giant electric car weighing more than 280 tons. By the beginning of 2030, Anglo American predicts to reduce greenhouse gas emissions by 30 percent. Most of the concept work has been completed, but UK-based Williams Advanced Engineering will try to implement a patented high voltage battery system for the mining truck, which is still under development. Their main idea is to replace our familiar diesel engine with an upgraded high-power modular lithium-ion battery. If the eDumper is a mining truck used to transport marl and lime from mountain slopes in Switzerland - fully adapted to clean electricity and physics as an energy source, then the Williams Advanced Engineering truck will be a hybrid, which will use both battery and lithium -ionic battery. This dump truck will have an energy reserve of more than 1000 k/h.

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Kiruscheva A, Kleschenok V., Hodkova M., Turcheniuk M.
Cryptocurrency

Belarusian National Technical University
Minsk, Belarus

Cryptocurrency is a number of units of counts which is written in a special order. It can be used to buy goods and services or to make secure online transactions.

The idea to create cryptocurrency started from some projects like “Hashcash”, “B-money” and “Bit Gold”. All of them were developed nearly at the same time, in 1990-s.

The main idea of the “Hashcash” is making less email spam and preventing DDoS attacks. Hashcash used a proof-of-work algorithm to promote the generation and new coins spreading, much like many contemporary cryptocurrencies.

“B-money” is an anonymous electronic cash system. The scheme is to do untraceable transitions without outside help.

“Bit Gold” is another electronic cash system, which is close to “B-money”. But solutions were compiled cryptographically and then published like a modern blockchain would function.

The main idea of cryptocurrency was to create a single digital currency and availed for everyone anonymous transactions. And it came true when a programmer (or a group of programmers) under pseudonym Satoshi Nakamot developed bitcoin.

Cryptocurrency is designed to suggest users a particular set of benefits over other payment ways. The pros are the following:

Protection from fraud. Cryptocurrency is encoded and also secure. It is supported by a specific system named

blockchain. Blockchain utilize volunteers to work with each other to encode the transactions, they make sure that all private data is hidden away from spies. Virtual currency is not centralized. Bitcoin contains servers around the world and more than 10 thousand nodes that track all transactions in the system.

Increasingly world-wide adoption as a payment method. Lots of merchants now accept digital currency payments (Subway, Home Depot, KFC Canada, Namecheap, Starbucks, Expedia and Whole Foods, etc.).

User independence. Digital currencies let users get more autonomy over their own finance than fiat currencies do.

Accessibility. Virtual currency is a decentralized system which can be utilized and available globally. Because users can transmit and receive digital money with a mobile device or a computer, in theory it is available to users without access to conventional banking systems, credit cards and other ways of payment.

Lower fees. Virtual currency includes peer-to-peer transactions, meaning they remove brokerage or intermediary fees, and comes with lower transaction contribution in comparison to other electronic payment methods such as credit cards and PayPal.

Rapid and immediate transaction. Cryptocurrency transactions are very quick compared to banking channels. A digital currency operation is as fast as an email and can be processed in 10 minutes.

In addition to its advantages, cryptocurrency has a lot of disadvantages and pitfalls.

Decentralization. Despite investing in digital currency so thrilling there's also high risk. Decentralization of digital currency manifests itself in absence of body or administrator overseeing the development, management and movement of the currency. Cryptocurrency exchanges do not have the same

level of governmental oversight or auditability as traditional banks.

Untraceable transactions. An exchange mode is complicated and difficult to track, so it's highly problematic to account for transactions made using existing cryptocurrencies. This property makes digital currency the perfect tool for criminal transactions.

Threat of decentralization. Blockchain security is only effective as long as honest miners control more computing power than a team of cooperating attackers. The main caveat regarding probabilistic assurance is that it assumes that no single miner controls most of the network. The system would cease to be decentralized, if a single miner or pool of miners have control over 51% of the nodes.

Vulnerability. In addition, many exchanges are regularly subjected to hacker attacks. Unlike cryptocurrencies, exchanges are not as secure, they are susceptible to various vulnerabilities, which makes them a prime target for attackers. Hacks are especially damaging because they usually affect thousands of users and lead to loss of funds. These incidents can impact any exchange but the biggest losses are borne by small exchanges.

Irrevocable loss of money. While banks can help you in the event of security issues such as a hacked or stolen credit card, cryptocurrency cannot be recovered if it is lost. There are currently no ways for returning lost money.

High volatility. The constant price fluctuation is one of the most significant disadvantages of cryptocurrencies. This instability is caused by media coverage, speculation and uncertainties as the currency is still in its infancy. Out of the charge of a central bank, the value of a virtual currency is highly volatile. As a result, entrepreneurs need to be constantly monitoring the value of the currency.

Cryptocurrency seems too complex and unreliable for mass use. For it to function as an established currency, there would definitely require to be an increase in consumer protection and regulation, which in turn will reduce the anonymity and increase transaction costs, two of the most attractive factors in cryptocurrency. In its current form, cryptocurrency is not likely to become an official currency for the general public, because of its many disadvantages and risks, while its strengths are not necessarily something people want in an established currency. However, the innovations associated with cryptocurrency can still be used. Very likely that some kind of realization of payment system and cryptocurrency technology could become the future of mainstream payment systems.

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Starinovich A.,Ivaskevich K., Riabychina A.,Turcheniuk.M

Economic Assessment of Pollution Damage

Belarusian National Technical University
Minsk, Belarus

The term pollution can be explained as the flow of harmful substances or other objects into the environment exceeding the natural background. The result of the pollution is called damage. Damage from the pollution can be considered in several aspects: economic, social, environmental, moral.

In the flow of history, the assessment of economic damage has been widely studied. Despite the constant improvement in the methodical basis, the current methods have many shortcomings. It is connected with the fact that the concept of economic damage is a single measure of assessing the man-made impact on different areas of society but its calculation requires many raw data, that are hard to be recorded or simply defy formalization. Though part of the social, moral, aesthetic and other damages can theoretically be expressed by valuations this is still beyond the limits of the capabilities of the modern economic techniques. So as a result the estimated economic damage is always understated in relation to the real one.

In foreign economic literature being studied, the problem of assessing damage is connected with the concept of ‘external effects’. The impact of economic activity on the environment intensified the research in assessing these effects only in the late 1970s. Economists believed that the amount of damage was misused in economic calculations, considering it wrong to summarize the various amounts of damage to various recipients

or to calculate some local damages, for example the "cost" of human life calculation.

To solve existing problems an extensive list of regulatory documents approved at regional levels was established. It governs the assessment and reparation of the damage to the natural environment, public health, natural resources, and various entities in legal relations and various economic activities. There are currently about 70 regulations that establish and explain the variety of aspects in this area.

Despite a wide list of regulatory and methodical documents and the long practice of calculating the size of claims due to violation of environmental legislation, the concept of actual "environmental damage" and damage done to the public health is almost nowhere clearly disclosed.

It is evident that economic assessment of pollution damage is necessary for the formation of a mechanism for the cost of environmental management.

In the data being studied there are two methods of economic assessment of pollution damage: direct account method (recipient method), indirect assessment (enlarged method).

The recipient method of economic assessment is used to summarize the losses suffered by each recipient (pollution victims).

1. Losses in kind for each recipient are determined.

2. Losses are translated into value.

3. All losses are added up and the result is a sum of damage as well.

Unfortunately, the use of the recipient method is associated with many difficulties.

The first step is to collect and process a large amount of information that is heterogeneous, with a variety of recipients and losses.

The second phase requires an adequate monetary assessment of the losses. It is difficult to do because of the lack of uniform standards and the uniqueness of each situation. There is a high probability of receiving an under-estimated or inflated estimate of losses under the influence of subjective factors.

Thanks to the use of control areas, analytical dependency method and combined method the task of determining the size of losses in kind is helps simplified. The method of control areas is to compare the ecological, economic and social indicators of a contaminated area with the indicators of a conventionally clean (control) area. Ideally, the contaminated area itself is considered as a conditionally clean area before contamination. Losses are the difference in the performance of these areas. The analytical dependency method is the statistical processing of evidence to assess the impact of the pollution factor on the recipient's condition. The combined method is a combination of the control area method and the analytical dependency method.

An easier-to-use method of economic damage assessment and pollution is a larger method, or a method of indirect damage assessment. Using this method, pollution is differentiated by pollutants (e.g. air pollution, water, land). For each object, a larger valuation of damage is used, as measured in rubles per conditional ton of pollutant (for reservoirs and atmospheres) or in the cost of replacing a unit of the damaged object with another (for land).

According to the research conducted the economic assessment of the damage from pollution of the natural environment consists of the following costs:

– the additional costs due to changes in the natural environment;

– the cost of returning the environment to its previous state;

– the cost of reducing pollution is taken into account when assessing damage to the natural environment;

– the cost of environmental restoration;

– additional costs due to changes in environmental quality.

It is also evident that to assess the economic damage caused by pollution are to pay attention to such types of pollution as air pollution, pollution of reservoirs, pollution of land, pollution of nature by physical factors and the damage to bio resources. According to these knowledge scientists have developed several methods to determine all types of damage from pollution of the natural environment.

Summing up the analysis of existing methods of assessment, it can be concluded that modern economic techniques do not allow estimating accurately the extent of economic damage. «Absolutely objective» assessments are not possible in principle because of the complexity of the very notion of pollution damage. Though there have been already some studies in terms of risk theory, social choice, social well-being, simple and extended reproduction, market valuation methods, cost method, alternative cost, cost of risk, cost of livelihood and many others there is still a fundamental need to develop new approaches, theories and methods of informal analysis.

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Silkou M., Negrusha O., Martynov A., Turcheniuk M.

Problems of Teenagers in Criminal English-speaking Countries

Belarusian National Technical University
Minsk, Belarus

According to the world ratings, Canada is one of the best countries to live in, but the problems with crime remain unresolved. For the fourth year in a row, Thompson, a city of 14,146 people in northern Manitoba, the largest in the region, has the highest crime rate, violent in particular. It has the highest rates of murders, assault, sexual assault, cocaine trafficking, and youth crime. The participants of such crimes are: membership in indigenous youth gangs is believed to be on the rise. The reasons for this are historical and cultural losses, social and political inequalities, and economic barriers that many indigenous peoples have faced for generations. These multiple levels of marginality can create conditions conducive to the formation of gangs and the involvement of young people in criminal activities. Participation in gang-related criminal activities can begin as early as the age of eight. The rate of domestic violence, including suicide, substance overdose, and other self-harming behaviors, may be higher than for some other forms of criminal violence

Official statistics are very limited in this sector. But a police survey conducted in 2003 found that among black youth, many are gang members, and this trend has continued. The over-representation of black youth in street crime and violence can be partly attributed to historical oppression and current socio-economic disadvantage. Studies have shown that the influence of race on gang membership and crime is due to

incomplete parentage, poverty, and social disorganization at the community level. In addition, perceptions of racial discrimination and feelings of social exclusion may also play a role. Racialized youth are often subjected to excessive control in the area of residence and are disproportionately disciplined in schools. This leads to a perception of social injustice and an increased likelihood of violent behavior.

This category faces linguistic, psychological, and economic challenges to integrate into Canadian society, sociocultural challenges to competing cultural expectations, cultural identity, and cross-cultural interactions, and certain barriers to accessing services and support in the areas of social services, education, health, and justice. The violation of identity and the lack of a sense of belonging can create a void in social identity and connections, which can push this category of young people to participate in gangs. Through these groups, these young people can gain social recognition and support by engaging in criminal behavior

Canada is often the victim of natural disasters. Frequent floods, large hurricanes, and forest fires leave people homeless. Left without a home, food and money, people begin to go to extreme measures. High crime rates reduce the quality of life of other people and society.

Various measures are being developed and implemented to reduce youth crime. One example is the existence of the GANG REDUCTION PROGRAM (GRP), which consists of complex projects funded under the National Crime Prevention Strategy in Canada.

Speaking about crime in India and its impact on children and adolescents, we will consider such groups of crime as:

- Child trafficking and abduction;
- Caste discrimination;
- Organized crime;

- Terrorism;

Child trafficking and abduction in India is one of the biggest problems for Indian youth. The main target in this caste is children. This is the conclusion reached by the NCRB. She analyzed the crimes-kidnappings committed against children in 2019. During that year, 69,054 children were abducted, which is 5.7 % more than in 2018. Although caste discrimination is prohibited by law in India, it is not illegal to do so.

Organized crime in India consists of various criminal syndicates that monopolize the field of education and health care, which in turn serves as a barrier to obtaining high-quality education and high-quality medicine, since a quarter of the population cannot afford it. These two factors affect the life expectancy of children and their involvement in education.

It is worth noting that Indian society was formed under the influence of one of the most ancient world religions – Hinduism. And one of the religious tenets of Hinduism is the division of society into different groups-castes.

Here we will talk about the problems of children in the Dalit caste, which is the lowest caste, whose rights are severely infringed. This group is the largest in India-it has about 170 million people, which is about 16.6 % of the population, of which about 57 million are children, for whom there are rules. According to the Jewish precepts, children of the Dalit caste can not play, communicate and touch children from other castes. Also, according to the Ministry of Statistics and Program Implementation, 13.4% of schoolchildren are harassed by their classmates because they belong to lower castes. This puts a lot of pressure on these children, which means that they have to stop learning, thereby not getting a high-quality, full-fledged education.

Terrorism is the fourth most important problem for Indian youth, namely for Western states such as: Rajasthan, Gujarat, Punjab and Haryana.

All these problems affect the mental development of children, and often such children become participants in criminal crime. It is worth noting that the weather conditions also contribute. After all, floods often occur in India and as it was previously written, it leads to an increase in crime.

But the Indian government is taking practical measures to reduce the caste qualification. For example, children from lower castes who attend schools (they are paid) are given a 50% discount on tuition. Jobs in government structures are also allocated for young professionals from lower castes.

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Grishan U., Chuprina K.

Greenhouse Effect and Its Consequences

Belarusian National Technical University
Minsk, Belarus

Today, people are conducting a kind of unplanned global experiment to reshape the entire planet. Destroying the ozone layer, thanks to which life on the Earth's surface is possible. Actions such as the use of fossil fuels in industry, deforestation, agrochemistry, waste burning at landfills, various types of transport have a negative impact on the composition of the biosphere and temperature balance. All this generates and enhances the greenhouse effect, which in turn puts our life and the life of the planet at risk.

The first mention of the nature of the greenhouse effect appeared back in 1827 in an article by physicist Jean Baptiste Joseph Fourier, who defines the greenhouse effect as an increase in the temperature of the lower layers of the planet's atmosphere in comparison with the effective temperature, that is, the temperature of the planet's thermal radiation observed from space ... As a result, the air temperature is higher than it should be, and this leads to such irreversible consequences as climate change and global warming [1].

For this reason, some scientists predict that in 200 years there will be such a phenomenon as the "drying up" of the oceans, namely a significant drop in water levels. This is one side of the problem. Another is that an increase in temperature leads to the melting of glaciers, which contributes to an increase in the water level of the World Ocean and leads to flooding of the coasts of continents and islands. The increase in

the number of floods and inundation of coastal areas indicates that the level of ocean waters is increasing every year.

An increase in air temperature leads to the fact that territories that are little moistened by atmospheric precipitation become arid and unsuitable for life. Here crops are dying, which leads to a food crisis for the population of the area. Also, animals do not find food, since plants die out due to lack of water. People are also under threat. An increase in air temperature leads to the development of the following diseases and epidemics: Ebola fever, babesiosis, cholera, bird flu, plague, tuberculosis, external and internal parasites, sleeping sickness; yellow fever [2].

These diseases spread very quickly geographically, since the high temperature of the atmosphere facilitates the movement of various infections and disease vectors. These are various animals and insects, such as Tsetse flies, encephalitis ticks, malaria mosquitoes, birds, and mice. From warm latitudes, these carriers migrate to the north, so people living there are exposed to diseases, since they do not have immunity to them [3].

Our country was one of the first to ratify the Paris Climate Agreement in 2015 and already has a clear plan of action: to rationally use energy resources and develop renewable, including carbon-free sources of generation. Such a concept as the "green square", which implies a combination of the energy of the sun, wind, water and atom, already operates in our country. By 2030, Belarus sets itself goals such as reducing total greenhouse gas emissions by 28% and increasing the share of renewable energy sources to 9% reduce the share of gas in energy production by up to 50% (Figure 1).

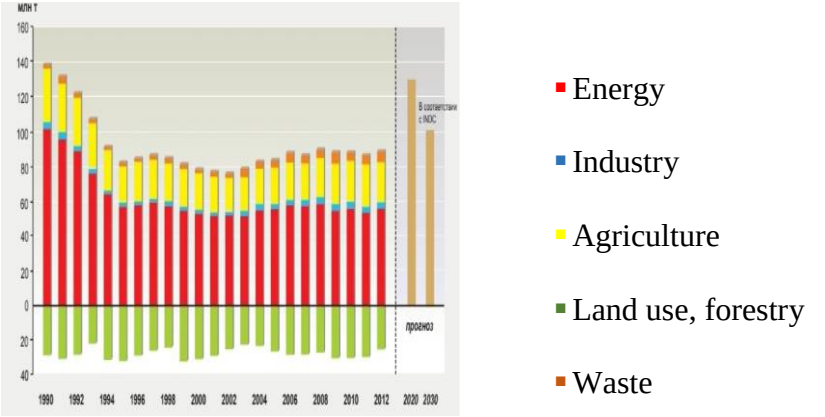

Figure 1 – Greenhouse gas emissions in Belarus and their expected change

Since the collapse of the USSR, the forest cover of the territory of Belarus has increased by 4%, and it continues to grow. At the same time, forestry is one of the most vulnerable sectors. Therefore, we have developed a strategy for adapting forestry to climate change until 2050. Adaptation strategies are also being developed for individual cities and regions. For example, IOO "EKOPROEKT" prepared such documents for the Sporovsky and Motolsky village councils and the city of Chausy within the framework of the EU project "Climate Forum East". 38 cities of Belarus are participating in the Mayors' Agreement on Climate and Energy - this is an EU initiative that any city can join. Bykhov, Bobruisk, Verkhnedvinsk, Vitebsk, Volkovysk, Gorodok, Dokshitsy, Ivatsevichi, Kalinkovichi, Krasnopolye, Korma, Mosty, Mstislavl, Nesvizh, Novopolotsk, Pruzhany, Svetlogorsk, Slavgorod, Slutsk and Smorgon and others [4].

Local governments voluntarily commit themselves to reduce greenhouse gas emissions by at least 30% by 2030 on their territory. In Belarus, for instance, the project is

coordinated by Ecopartnership International Public Organization and the Interakcia Foundation.

Renewable energy sources currently account for approximately 5.5% of the country's energy balance. For example, wind turbines have a capacity of 75.8 MW. This figure is projected to increase to 500 MW by 2030. The largest wind farm is located near Novogrudok, with a capacity of 9 MW. As for solar power plants, the largest of them near Bragin was built by Velcom. The installation with a capacity of 18.48 MW covers an area of 60 football fields [4].

Thus, the greenhouse effect becomes the cause of global warming, and this leads to many ailments and infectious diseases. As a result of epidemics, thousands of people die around the world. By fighting the problem of global warming and the greenhouse effect, we will be able to improve the environment and, as a result, the state of human health.

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Khaletsky E., Putilovsky V., Chuprina K.

Methods of Electric Power Transmission and Optimization

Belarusian National Technical University
Minsk, Belarus

Nowadays, electrical appliances are widely used and many types if equipment working on it. The main problems of our time in this regard are the following: energy transfer, reduction of losses and optimization of the operation of devices. In this work (in this article) we will try to reveal the methods that are being used now and innovative developments that will change the idea of technology and make our life much more convenient and safer.

At the moment there are two main methods of electrical transmission. They are air and cable. Air transmission means the transmission of energy though wires suspended on supports while cable transmission is carried out through cable lines laid underground or in special engineering systems. Based on the purpose of the power line (transmission line) is classified depending on the voltage used. Thus, there are the following voltage levels used in power lines in Belarus: low-voltage (no more than 1 kV), medium-voltage (1-35 kV), high–voltage (110.0-220.0 kV), ultra-high-voltage (330.0-750.0 kV), ultra-high-voltage (more than 750 kV) [1].

When transmitting energy, a large voltage is used which reduces energy losses after which the energy is converted lowering the voltage and distributed among consumers. In addition, costs can be reduced by lowering the resistance or lowering the current. The second method is most favorable, since the first method increases the cost of cable production by increasing their cross-section. To point out the ways to

optimize electricity it is advisable to consider the purpose of power transmission lines. Thus, power transmission lines are classified as follows, depending on the purpose: for ultra-long distances, main purpose, distribution, and consumer. Ultra-long distances power transmission lines are used to connect individual power systems. They are estimated at more than 500 kV. Main purpose power transmission lines provide assistance in energy transmission and are combined into single system. They equal about 220-330 kV. Distribution power transmission lines supply enterprises and large sites. They are estimated at approximately 35-110 kV. Consumer power transmission lines are used to direct energy to consumers. They equal up to 20 kV [2]. When we deal with the transmission of electricity, two ways of transmitting energy are used. They are alternating and direct current. The first way has become more widely used, since the stations are equipped with alternating current generators and when transmitting current in this way, a special three-phase current technique is used for long-distance transmission. But when transmitting over long distances, the second way is more effective, and it has many advantages: the absence of the influence of the length on the power, which increases the distance of the lines; static stability is not taken into account; simplification of the design due to the two-wire and single-wire system, thereby reducing costs; there is no need to synchronize the frequency of the connected power systems; reactive power is practically absent and the influence of electromagnetic waves on the means of communication is reduced. It should be mention that static stability is the ability of a power system to return to a steady state after small disturbances in the regime, in which the changes in parameters are very small compared to their average values. As for reactive power it is power that was not transferred to the load, but led to heat and radiation losses, is called reactive power [3].

This method has not been widely used due to the high cost of equipment and implementation of the method. There is also a wide-spread method of superconductivity based on lowering the temperature to ultra-low, which allows you to transfer energy most efficiently, with the least loss. It was not widely used, as well as by the direct current method due to the high cost, complexity of implementation and lack of technologies that allow implementing this method. Thus, we have considered the transmission of electricity by direct transmission and now we will deal with the conversion of electricity into another type of energy.

Let's start with the method of optical radiation, in which energy is transferred using visible light, infrared radiation, ultraviolet radiation. This method allows you to transfer energy, lasers and solar cells. An example of use can be optical fiber. Another method is magnetic fields. When using inductive coupling energy will be transferred by magnetic fields and to implement this method, we need turns of wire (coils) which allows us to transfer energy over short distances and overcome obstacles. This method is implemented in wireless charging. One more method is permanent magnets. Magneto dynamic coupling that is realized by means of magnetic fields and is transmitted by rotation of permanent magnets. An example of the implementation of this method can serve as the development of floating lamps.

Another method is resonant inductive coupling. It is the wireless transmission of near-field power between magnetically coupled coils, which is part of a resonant circuit tuned to resonate at the same frequency as the drive frequency operates at a certain frequency and transmits energy due to magnetic fields and is transmitted due to oscillatory circuits.

Microwave radiation is another method that presents electromagnetic radiation, including the decimeter, centimeter and millimeter ranges of radio waves, microwave frequencies

are exceeded from 300 MHz to 300 GHz. It is transmitted by means of microwave waves due to phased rows of parabolic antennas. The capacitive coupling, in turn, based on an electric field, is transmitted by means of electric plates [4].

In conclusion, at the moment there are many ways to transmit electricity, all of them are improving and becoming more efficient and cheaper but the full potential of each of the methods has not been established so far. With the invention of new technologies, the transmission of electricity without loss over long distances seems more and more possible every day.

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Kharlan K., Rudoy D., Chuprina K.

The Use of Wind Generator

Belarusian National Technical University
Minsk, Belarus

Today, when environmental problems are gradually becoming one of the main concerns of humanity, the use of different energy sources is considered to be not only effective, but also influence positively. Energy production, which is a necessary means for the existence and development of mankind, has a great impact on nature and the human environment. On the one hand, heat and electricity have become firmly embedded in human life and production activities that a person cannot even imagine his existence without it and consumes inexhaustible resources. On the other hand, people are increasingly focusing on the economic aspect of energy and demanding environmentally friendly energy production. This indicates the need to address a range of issues, including the redistribution of funds to cover the needs of humanity, the practical use of achievements in the national economy, the search and development of new alternative technologies for generating heat and electricity, etc.

Today, all scientists in the world face the problem of finding and developing new alternative energy sources. In this article, we will consider a method for generating electricity by means of wind turbines. A wind generator is a device that uses wind energy to generate the electric current. Airflows that move freely in the atmosphere have a gigantic energy and completely free of charge. Wind energy is an attempt to extract it and turn it to good use [1].

The use of diesel or gasoline power plants is unprofitable due to the constant increase in the cost of fuel and the significant damage that is caused to the environment when using this method of energy production. At the same time, wind energy uses absolutely free and inexhaustible energy without harming the environment and changing the surface relief. Therefore, it is necessary to implement while creating a hydroelectric power station.

The movement of airflows has a high-energy potential and should be used to produce electric current. Those regions that do not have the capacity to use other methods, intensive research and development in this area is being carried out having its results in the form of large wind power stations. They consist of separate wind turbines with high power and are combined into a single power system.

The wind with its pressure rotates the wheel with blades, which, by means of a gearbox, transmits the resulting torque to the shaft. The paddle wheel converts the kinetic energy of the wind into the mechanical energy of the rotor. The shaft with the rotor of the wind generator, rotating in its stator, generates a constant electric current for us. The power of the wind generator can be from 5 kW to 4.5 MW. Modern devices generate energy even very weak wind-from 4 m/s [2].

The advantages of wind turbines include self-start at a wind speed of 1.5 m/s and self-spin at a wind speed of 3.5 m/s, smooth operation due to the displacement of the blades fixed on the top cover of the wind generator relative to the monolithically fixed box. The blades are fixed on the top cover of the generator, which is easily displaced relative to the body due to neodymium magnets hovering over each other (these magnets act as bearings). Due to the lack of friction between the magnets, it is easy for the blades to unscrew the generator cover which neodymium magnets are also attached to from the

inside. It is important to mention that there are coils made of copper between the poles of sliding blades.

There have been a huge number of developments for generating electricity using wind energy so far. Moreover, independent inventors achieve the most successful results in this field. The focus is placed on achieving maximum performance and sensitivity of the rotor, stability of rotation and resistance to overload.

The issue of energy security has always been one of the most urgent for Belarus. The country's own fuel and energy resources cover only 15 % of total consumption. In order to promote the development of renewable energy sources and the use of local fuels, the national program for the development of local and renewable energy sources for 2011-2015 and the strategy for the development of the energy potential of Belarus until 2020 have been developed. One of the most promising areas for implementing the goals of these projects is the development of Belarusian wind energy. Belarus has significant wind energy resources estimated at 1,600 MW and an annual electricity generation of 2.4 billion kW·h. On the territory of our country about 1,840 places have been identified that can provide a suitable and reliable site for placing wind turbines and wind farms. These sites are mainly rowings of hills with a height of 250 m. above sea level where the average wind speed ranges from 5 to 8 m/s. Each of them can accommodate from 3 to 20 wind turbines. As of January 2011, the total installed capacity of wind power plants in Belarus is 1.56 MW.

The development of wind energy in Belarus is promoted by state programs and plans aimed at stimulating the use of renewable energy sources. At the same time, there is a need to attract external investment, to intensify the search for ways to reduce the cost of wind turbines. It is necessary to train qualified personnel, expand the legislative framework

regulating the issues of tariff and tax policy, design and operation of wind turbines and wind farms, as well as to assess the impact of wind turbines on the environment. Guaranteed production of recycled wind energy from 7% of the territory of Belarus will amount to 14.65 billion kW·h. The use of zones with high wind activity guarantees the production of wind generator energy up to 6.5-7.5 billion KW·h with a payback period of 5-7 years [3].

Based on the wind energy potential only in the Minsk region there are 1076 construction sites for the placement of 3 to 10 wind generators with a capacity of up to 1000 kW each. Accordingly, the average annual saving of liquid fuel will be more than 800 thousand tons. The payback period for capital investments in wind power engineering is comparable to the payback period for small hydroelectric power plants, combined-cycle or gas-fuel-oil power plants and is significantly lower than these terms for coal, nuclear and diesel power plants

Today, wind turbines are a high-tech product with a capacity from 5 kW to 4.5 MW of single power. Wind generators of modern designs allow using economically efficient energy of even the weakest winds-from 4 m/s. With the help of wind generators, today it is possible not only to supply electricity to the "grid", but also to solve the problems of power supply to local or island facilities of any capacity. Wind turbines are used in a wide variety of places. These are open areas with good wind potential, fields, islands, shallow water, and mountains. Wind generators can operate either singly (a single complex) or in groups (a wind farm). Often, one or more wind turbines operate in parallel with diesel generators as a means of saving diesel fuel costs.

To sum up, we have considered the operation, types and application of wind generators. After having studied the

advantages of wind turbines they seem to be a powerful and reliable source of energy.

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Kolchin M., Stukach O., Chuprina K.

Nuclear Power

Belarusian National Technical University
Minsk, Belarus

Nowadays people are looking for additional sources of energy that can tackle the problem of the conservation of fossil fuels and the reduction of waste. One of the solutions is to use nuclear energy. Nuclear energy is generated by splitting the atoms in the reactor, the released energy heats the steam, and the steam already turns the turbine that generates electricity. Nuclear power plants do not emit harmful substances into the atmosphere, because reactors use uranium as fuel, not oil and gas, unlike thermal power plants that operate on the same principle. In addition, modern nuclear power plants are much safer than classical thermal power plants. All that power and potential comes from a tiny atom.

Now let us consider the advantages of this type of energy. Nuclear energy provides large amounts of 24/7 carbon-free electricity now, which is irreplaceable in protecting the environment. The question on the radioactive waste disposal tops the agenda. The waste from the plant is collected in special capsules, which are stored for a certain time, and later is disposed of in a safe way for production and the environment.

Having considered the issues on the radioactive waste we should turn to the economic and social question. Due to the high efficiency of a nuclear plant and relatively cheap raw materials and, as a consequence, the efficiency of the plant to produce large amounts of energy, both for consumers and great production, energy produced by a nuclear station will be much

cheaper than similar energy produced in thermal or electric power stations.

Having pointed out the advantages let us consider the disadvantages of nuclear power plants. Firstly, it is the high cost of design, construction and operation. Nuclear plants provide cheap energy but not free. The huge amount of energy generated at the station must be covered by the presence of a large number of consumers, as people and large enterprises, if they are not present, the station will become unprofitable and useless. Also, unlike a thermal power plant, a nuclear power plant does not generate the thermal energy needed to heat homes. Since this huge object is of state value, it requires a lot of competent specialists, whose work and knowledge should be paid well.

As for our country the government is encouraging the implementation of this type of energy. The idea of building the first Belarusian nuclear power plant arose in the mid-80s of the last century, a few years later the idea turned into reality, the first stages of construction began. But after the tragedy at the Chernobyl nuclear power plant, the project of the Belarusian nuclear power plant was frozen, and a little later resumed, but with multiple changes, including in the design, which led to changes in the project from the Belarusian nuclear power plant to the Minsk TPP-5. A decade later, it was decided to build the first Belarusian nuclear power plant. This decision had several prerequisites: the banal need of the country's energy system for a powerful facility capable of generating enough energy to operate the main industries of Belarus; independence from energy raw materials supplied from other countries, in the absence of them in the Republic of Belarus; the ability to sell electricity to neighboring countries; and, of course, this is the flagship of the energy industry of the Republic. After comparing all the above, a firm decision was made on the construction. Several options were proposed as the construction

site: Krasnopolyanskaya site, Kukshinovskaya site, Verkhnedvinskaya site, Ostrovetskaya site. Eventually, the choice fell on Ostrovets. This decision is due to several factors, namely the close location of the main electricity markets in the form of Lithuania, Latvia and Poland. Another explanation on the choice of this site is the safety associated with the absence of serious seismic activity, and the movement of tectonic plates in this area.

To understand the operation of a nuclear plant we should deal with its units. Oddly enough, this is quite simple, even a person far from the topic of energy can easily understand the purpose of the main units and units of nuclear power plants and the principle of their operation, comparing these units with their counterparts in the figure below (Figure 1).

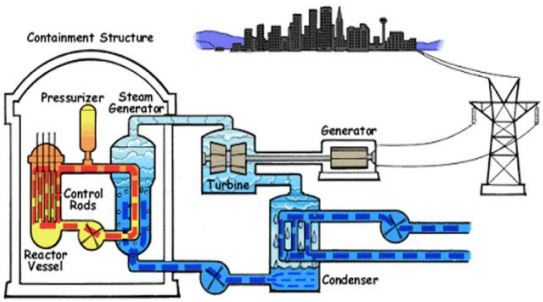

Figure 1 – The principles of the operation of nuclear power plant units

In Figure 1 we can see that the first step is the main circulation pumps pump water through the reactor core, where it is heated to a temperature of 320 degrees due to the heat generated during the nuclear reaction. The heated heat carrier gives its heat to the water of the second circuit (working fluid), evaporating it in the steam generator. After that the cooled coolant reenters the reactor. At this time the steam generator produces saturated steam at a pressure of 6.4 MPa, which is fed

to the steam turbine. In consequence of this the turbine drives the rotor of the electric generator. The spent steam is condensed in the condenser and refed to the steam generator by the condensate pump. To maintain a constant pressure in the circuit, a steam volume compensator is installed. The heat of steam condensation is removed from the condenser by circulating water, which is supplied by a feed pump from the cooler pond. Both the first and second reactor circuits are sealed. This ensures the safety of the reactor operation for the personnel and the public.

To sum up, it is essential to point out that nuclear power is really the future of all mankind, no alternative energy sources can compete with nuclear power plants in terms of reliability of power, durability, safety and, of course, cheap energy. As in conclusion, alternative energy is more expensive and, as a rule, no more harmful than nuclear energy.

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Samuticheva E., Chuprina K.

The Potential of Solar Energy in Belarus

Belarusian National Technical University
Minsk, Belarus

The demand for alternative energy is constantly increasing. In each country this is caused by different reasons. For example, in Africa, this is due to a large amount of heat and a lack of other resources. In addition, there is absolutely no developed solar energy infrastructure. Therefore, the construction of a plant from scratch is much more profitable than the construction of a traditional thermal power plant. It is essential to mention that this initiative toward developed draft programs on the use of solar energy is even supported at the governmental level.

If we consider the countries of America, Asia and Europe, here the demand for alternative energy is also quite high, but reasons are different. These countries are encouraged to build installations by the high cost of electricity. If you invest in solar panels, they will pay off in 2-3 years and will sufficiently provide the house with heat and hot water [1].

The main source of energy is the sun. Therefore, the energy sphere has been actively developing in recent years. Solar energy is used in various activities and its relevance is growing every year. Modern solar panels consist of a chain of solar cells-semiconductor devices that convert solar energy directly into electric current. The process of converting solar energy into electric current is called the photovoltaic effect. This phenomenon was discovered by the French physicist Alexander Edmond Becquerel in the middle of the XIX century. The first active solar cell was created half a century

later by the Russian scientist Alexander Stoletov. Consequently, the photoelectric effect was quantitatively described by Albert Einstein the 20th century. A semiconductor is a material atom of which either have extra electrons (n-type), or vice versa, they are not enough (p-type). Accordingly, a semiconductor solar cell consists of two layers with different conductivity. The n-layer is used as the cathode, and the p – layer is used as the anode. Excess electrons from the n-layer can leave their atoms, while the p-layer captures these electrons. It is the rays of light that "knock out" the electrons from the atoms of the n-layer, after which they fly into the p-layer to occupy empty spaces. In this way, the electrons run in a circle, leaving the p-layer, passing through the load (in this case, the battery) and returning to the n-layer [2].

The largest solar station in Belarus is located in Rechitsa. For the implementation of the project, two land plots have been assigned in the Rechitsky district with a total area of 110 hectares. There are 218,430 solar panels installed here. The total investment in the implementation of the project near Rechitsa is estimated at about 65 million euros. As explained in the State Enterprise "Belorusneft", borrowed funds have been used for the purchase of equipment, and own resources have been used for construction and installation works [3].

The largest productivity of solar panels in terms of electricity output falls on the sunny months: from mid-April to the end of September. Despite this, solar energy can still be generated on cloudy and rainy days, but in smaller amounts. In addition, solar energy is expected not to be produced at night.

Eco-activists advocate to eliminate any sources of pollution of the planet, especially in the air and water. Even though the types of pollution that are associated with solar panels are smaller compared to other types of alternative energy, the solar alternative can still have a negative impact on the environment. For example, in the production of solar panels

and photovoltaic systems, some toxic materials and dangerous products are used, and the disposal process is not always clear. Also, it is worth considering that the transportation and installation of solar panels means the release of greenhouse gases into the atmosphere.

However, the technologies for the production and installation of solar panels are constantly being improved. So, there is an optimistic forecast that over time, the options for recycling solar panels will improve. As a result, the environmental benefits of switching to solar power now outweigh the dedication to legacy utility energy companies. In addition, innovations in the field of quantum physics and nanotechnology can increase the efficiency of solar panels and consequently double the electrical power of solar energy systems. In total, there are 31 solar stations with a total capacity of 41 MW in Belarus. According to the state program "Energy Saving", Belarus will have planned to build at least 250 MW of solar power plants by 2022.

The second-largest station is located near Bragin. Its rated power reaches 18.48 MW. The solar station was built by A1. It covers an area of over 41 hectares and the station itself is estimated at 24 million euros. Belarus has more than 3.8 thousand facilities with an installed capacity of more than 6.2 thousand MW, which produce electric and thermal energy at the expense of renewable energy sources including: 31 solar plants, 17 biogas plants, 66 wind power plants, etc.

By the beginning of this year, the share of RES in the gross consumption of fuel and energy resources in Belarus was 5.5%. In the total balance of renewable energy sources, firewood accounts for 54.1%, fuel chips-25.5%, wood waste-13.1%, water energy-1.7%, wind energy-0.6%. By 2020, the share of RES in the gross consumption of fuel and energy resources is planned to increase to 6% were invested in the implementation of the project [4].

To sum up, the potential of solar energy has been considered together with the advantages and disadvantages of the solar panels. Moreover, the development of this type of energy particularly in Belarus has been analyzed. Thus, our country is currently putting a lot of efforts in the development and encouragement of different programs on the implementation of solar energy. If we use and rely on it, we can conserve our resources and our planet.

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Stasevich A., Chuprina K.

The Depletion of Natural Resources

Belarusian National Technical University
Minsk, Belarus

From the first generation the world's population lives with a constant fear of environmental disasters. Logging of forests, pollution of the ocean, destruction of the ozone layer - we have heard these words in our lives hundreds, maybe thousands of times. Humans have interacted with and influenced their environment from the very moment their species emerged. In fact, this influence reached a noticeable scale only in the eighteenth century, with the beginning of the industrial revolution. At this moment, man left the natural cycle of nature and began to impose his own rules on the planet.

The earth began to change, but we saw it far away at once – our civilization was carried away by other things: the extraction of fuel, alloy and other minerals. All these substances, excreted naturally and withdrawn by man, returned to nature, but in a slightly different form. It all turned into global pollution of soil, water and air and became the root cause of the ecological crisis. And the intensity of this process continues to grow rapidly, and humanity will have to eliminate the serious consequences of the ecological crisis in the near future. And one of the most important problems today is the problem of depletion of natural resources. The lack of natural resources directly affects half of the world economy, and indirectly – absolutely all sectors of the economy. The modern world economy is characterized by extremely high rates of extraction of natural resources in comparison with their ability

to renew: overcutting of forests, overgrazing of livestock on pastures, overfishing, low quality of agrotechnical measures during tillage and depletion of its fertility, pollution of water bodies and watercourses with industrial emissions up to the impossibility of their further use, air pollution in large cities, etc. The formation and progress of society are associated with an increase in the depletion of natural resources.

Reduction of natural resources can be classified into two types: depletion of non-renewable fossil energy resources of biogenic origin (coal and oil). Despite the existence of the necessary supply of such minerals, now some countries are developing the use of alternative inexhaustible sources of energy: wind, ebb and flow, solar radiation, etc. And the second type: reduction of renewable resources (soil and forest). The depletion of the soil cover of the land is associated with erosion, which strongly affects the volume of the fertile layer. It has been proven that a number of the most ancient civilizations have disappeared due to the excessive use of the soil layer. For example, the Sahara Desert was once the richest province of the Roman Empire. Now all sorts of parts of the globe are becoming deserted due to deforestation, the destruction of shrubs and the grass layer. Due to the continuous plowing of the soil, dust storms, wind and water erosion of the soil layers appear [1]. To ensure society at a particular moment of development, natural resources are divided into real and potential. Real natural resources are those that have been explored at this stage of the development of society, their reserves are quantitatively determined and are actively used by society. As society develops, they change. For example, at the initial stage of the formation of the industry, whale oil was freely used as a fuel; at the present stage of development of society, one of the leading energy resources is electricity generated by hydro-heat and nuclear power plants. Potential natural resources are resources that have been explored at this

stage of the development of society, and often quantitatively determined, but are not used due to one or another primary reason (poor technical equipment, lack of appropriate processing technology, etc.) For example, potential land resources are allowed count desert, mountainous, swampy, saline and permafrost areas. Despite the enormous need for arable land and land resources, people are unable to develop these lands for agriculture: large investments are needed.

The resources without which human life is impossible include, first of all, air and water, and in addition energy and raw materials. The problem of water resources is considered one of the most acute in the world. Fresh water is an insignificant part of the Earth's water balance - it is only 3%. Its main part is concentrated in the ice of the Arctic and Greenland, while rivers and lakes account for a very small share. Energy resources are shown by reserves of fossil fuels, including oil, gas, coal, oil shale. Raw materials are, first of all, mineral raw materials, which include components necessary for industrial production [2].

Since the second half of the 20th century, the scale and rate of extraction of mineral raw materials (oil, gas, coal, minerals) has greatly increased. At the same time, an impressive part of the currently known reserves of mineral resources lie in difficult conditions or are represented by relatively poor deposits. Their development requires much more capital investments than before, and a more advanced production and processing system. The use of electricity is increasing at a similar rate. Thus, the main sources today are still non-renewable material resources: oil, coal, gas, peat, uranium. The search for "fresh" alternative energy sources and the introduction of energy-saving technologies are very slow. Economists have calculated that the total cost of obtaining energy from unconventional sources (sun, wind, sea tides, geothermal waters) is 15-30 times higher than the average costs

associated with the production and transportation of oil from the Middle and Middle East to Europe. The development of nuclear energy is held back by the negative attitude of the world community. Energy saving itself does not have the ability to become an alternative to energy sources.

Currently, society is preparing to use the energy of thermonuclear fusion. However, the scenario of scientists for the future assumes that the energy well-being of the developed countries of the world will, as before, be created most of all at the expense of economically underdeveloped oil-producing countries. At the same time, even if the growth rate of oil consumption does not grow, its proven reserves will probably last for about half a century.

There is currently no clear information as to how long a society can consider itself to be supplied with fossil fuels and minerals. However, it is obvious that their savings are exhaustible and non-renewable. Therefore, developed countries are now focusing on the development of non-material-intensive industries, such as, for example, electronics. The energy revolution of the 70s taught a lot about the energy resources of the Western countries. Since then, fundamental measures have been taken and implemented for a significantly more economical use of oil products, and strategic reserves have been built. For Belarus, as well as for other countries, it is a problem of depletion of natural resources. For example, a nuclear power plant in Ostrovets has now been built, which means that the amount of consumption of non-renewable material resources for fuel production will increase. This cannot be avoided, because the search for new alternative sources takes a very long time. But our country, like many others, is not standing still and is looking for solutions to this problem.

Society at the moment comes to understand that the elements of economic activity are just an element of human

activity, which means that the development of the economy should be analyzed as part of a broader concept of the formation of society as a whole. Of course, economic development implies great benefits from the use of natural resources.

However, after they are depleted, society will face new challenges that could lead to its complete disappearance. In the world economy, the problems of preservation and reproduction of the natural environment are gaining importance. Thus, natural resources have become the most key factor in wars and confrontations in the history of mankind, and this may become a problem in international relations in the future. It is no coincidence that the onset of the ecological crisis was combined with the post-industrial scientific and technological revolution. During the scientific and technological revolution, conditions are being formed that remove technical limitations in the use of all kinds of natural resources. Industrialization processes have significantly increased the power of people over natural processes, and at the same time, the number of the population that lives in direct contact with nature is decreasing.

As a result, the inhabitants of industrialized countries have become even stronger to believe that their mission is to conquer nature.

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Korotkaya E., Yalovik E.

Evolving the Narrative for Protecting a Rapidly Changing Ocean, Post-COVID-19

Belarusian National Technical University
Minsk, Belarus

The ocean is the linchpin supporting global health and well-being. Despite the ocean being considered ‘remote’ and largely inaccessible, this has not protected it from many impacts of human activities (Stoknes, 2015; Lubchenco & Gaines, 2019). Only 3% is now recognized by researchers mapping ocean impacts as having no discernible human impact (Halpern et al., 2015).

In the context of COVID-19 and human health more generally, the diversity of ocean life also provides a genetic storehouse of adaptive potential in the face of a changing climate (Blasiak et al., 2020). It is the source of new pharmaceutical products, which have been discovered at rates of up to 2.5 times the industry average (Blasiak et al., 2020).

Pandemics such as COVID-19, alongside all the human suffering and loss, may have brought a small pause to human activity, but this is still outweighed by the human footprint of exploitation and destruction. Although the risks posed by damage to the ocean from the direct and indirect impacts arising from human activities may be less clear to many people, that damage is resulting in increasingly severe climate disruption and sustained loss and degradation of ecosystem functions [1].

The reality is that the ocean is still a largely ignored part of the Earth system, with insufficient protection and management. The ocean cannot be directly ‘managed’, but our

activities can be managed, and in this way reduce impacts on the ocean. Similarly, precision is lacking in other related areas.

The new target of ‘at least 30%’ as a global target for coverage of the ocean by fully or highly protected MPAs (Horta e Costa et al., 2016) - the level of protection that will most benefit biodiversity (Zupan et al., 2018a) - is clearly and specifically worded, yet time and time again the ocean conservation community refers to the target as ‘30%’. The phrase ‘at least 30%’ is a direction, whereas ‘30%’ is a definitive destination. Alongside direct, often local, management issues, such as overfishing, pollution, and habitat destruction, a new range of global climate-related drivers are significantly increasing pressure on the ocean. In the last 15 years, six major areas of concern have been documented in the scientific literature, which are now widely recognized as issues of global concern (e.g. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), 2019.

– Significant and accelerating heating of the ocean and associated oxygen loss.

– Significant sea-level rise and linked loss of coastal natural protection.

– Significant regional acidification with a worsening trend.

– Significant alterations to wind regimes and perturbations to major ocean currents and upwelling systems, which shape ocean ecosystems and human societies.

– Significant changes in patterns of ocean primary production, ecosystems, and species distribution resulting from increased warming and stratification at low to mid latitudes and decline of sea ice.

– Significant impact on marine [2].

Leading marine scientists created a six-point post-COVID-19 narrative:

1. All life is dependent on the ocean. We depend on the ocean for all life on Earth; it nurtures us, but we have done woefully little to nurture it.

2. By harming the ocean, we harm ourselves. All ocean activities need to be carried out more responsibly with the curtailment of damaging actions that affect current and future values.

3. By protecting the ocean, we protect ourselves. Humanity's reliance on the ocean means we must protect it to protect ourselves.

4. Humans, the ocean, biodiversity and climate are inextricably linked. The ocean modulates the climate and humans influence the state of the ocean and its biodiversity - what is needed is joined-up action and solutions.

5. Ocean and climate action must be undertaken together. If you are not factoring in ocean impacts and solutions, you are not effectively addressing climate breakdown.

6. The degree of ocean change requires action now. We have no choice. We need to act now or risk closing off future options for action [1].

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Pashkuro N., Yalovik E.

Asteroid Mining

Belarusian National Technical University
Minsk, Belarus

Our planet is filled with useful minerals, but as technology develops, our requirements rise. As a matter of fact, scientists worked out plans of space development. Space objects contain large amounts of resources, which are in lack on the Earth. Space mining can be performed on comets, asteroids or other planets. Although because of our relatively primitive technologies, now it is impossible due to economic inefficiency. There are about 1500 asteroids that are as easy to reach as the Moon. Their orbits cross with the orbit of the Earth. These asteroids are convenient for such tasks because of their small gravity field. On the Earth heavy metals drowned deeper to the core when our planet was forming. On asteroids all minerals are distributed throughout the object. Thus, it is much easier to reach them. Asteroids can contain such rare minerals on the Earth, as nickel, Platinum Group Metals (PGM), gold, gems. Volumes of deposits on the Earth can barely be compared with such on asteroids. Asteroids can contain not only technical resources, but also substances, necessary for modern industry of food production such as phosphorus, antimony, nitrogen.

For now, asteroid mining stays extremely economically risky. Some analyses show us that cost of returning industrial amounts of asteroidal resources will be such high that it won't attract private investments. There are four possible techniques of asteroid mining:

1. In-space manufacturing;

2. Delivery of raw materials;

3. Processing and delivery of processed materials;

4. Transportation of whole asteroid to close and safe orbit around the Moon or Earth [1].

For all these operations special equipment is required. The first step is to get to the asteroid. Due to the lack of atmosphere in space it is easy to move, but there are much more problems with getting of the Earth. There is salvation in fuel modules that will refuel orbiting ships. When ship will approach asteroid, it will dock with it by a harpoon. All mining equipment need to be automated due to very long communication time. Space law involves several international treaties, along with national statutory laws. Most of the developed countries admit that space and space resources do not belong to anyone. So, it is to be resolved, how they will share resources between each other.

All the necessity of asteroid mining is to extract and transport to the Earth minerals that are in lack. By that we spend large amounts of financial resources on projects that aren't proven effective. I think that we need to postpone such program for «better days» and start to spend our planet resources rationally to avoid the Earth exhaustion [2].

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Shakun M., Strukov A, Komissarova D.

A Healthy Lifestyle

Belarusian National Technical University
Minsk, Belarus

Protecting your own health is an immediate responsibility of everyone, he has no right to shift it to others. After all, it often happens that a person with an incorrect lifestyle, bad habits, inactivity, overeating by the age of 20-30 brings himself to a catastrophic state and only then remembers about medicine. Health is the first and most important need of a person, determining his ability to work and ensuring the harmonious development of the individual. It is the most important prerequisite for the knowledge of the surrounding world, for self-affirmation and happiness of a person.

An active long life is an important component of the human factor. A healthy lifestyle (HLS) is a lifestyle based on the principles of morality, rationally organized, active, working, tempering and, at the same time, protecting against adverse environmental influences, allowing you to maintain moral, mental and physical health until old age.

As defined by the World Health Organization (B03), "health is a state of physical, spiritual, and social well - being, not just the absence of disease and infirmity."

Physical education and sports are especially important now, in the age of the technological revolution, when mechanization and automation are being introduced at a rapid pace in industry and agriculture. The work of many workers is gradually reduced to the management of machines. This reduces the muscular activity of workers, and without it, many organs of the human body work at a reduced rate and gradually

weaken. Such muscle underloading is compensated for by physical education and sports. Scientists have found that physical education and sports have a beneficial effect on labor productivity. In physical and mental workers engaged in sports, fatigue occurs much later than in non-sports workers. Many years of scientific research have shown that people who are engaged in sports, in certain professions, quickly acquire high qualifications. Work with great nervous tension, such as the work of pilots, high-speed train drivers, car drivers, requires special psychophysical training. Physical education is a great help here.

Physical education and sports also provide an invaluable service in the formation of high moral qualities among young people. They cultivate will, courage, perseverance in achieving goals, a sense of responsibility and camaraderie.