VIRTUAL AND ACCESSIBLE REALITY TECHNOLOGIES IN THE TRENDS OF MODERN ENTERPRISE COMPETITIVENESS

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Abstract. In today's dynamic business environment, any business organization strives to maintain its own competitive advantage in the market. Therefore, each company develops and implements methods that allow not only to maintain a stable position, but also to develop and increase the scale of activities in a particular area. Such methods include various innovative solutions, attraction of highly qualified personnel, improvement of management system, changes in technological processes in production and many other things. Recently, however, so-called virtual reality technologies (VR-technologies) have become increasingly popular among companies. They are becoming increasingly important due to the rapid development of information and communication and digital technologies, which greatly facilitate and diversify the lives of most people and organizations. Virtual reality technology is slowly entering the workplace and is used in many fields such as medicine, construction and design, automotive, military, logistics, architecture and design, education, sports, engineering, design, tourism, and more. The main advantage of such technologies is the possibility of complete immersion into the created reality, additionally acquired ability to feel and analyze both positive aspects and negative consequences of planned actions, as well as to simulate options for future events. Therefore, the use of modern VR technologies by more and more organizations plays an important role in the development of their competitiveness. According to scientists and practitioners, the benefits of using such technologies are, first, to create added value for consumers through a new set of skills and knowledge; second, to give the organization a virtual competitive advantage; third, the achievement by the company of greater flexibility, dynamism and persuasiveness when using virtual reality to demonstrate its product (for example, to disassemble and assemble its own products in order to explain the internal mechanism or something else); fourth, reducing the duration of the production process, which uses VR technology; fifth, reducing costs and increasing profits for the organization by optimizing processes, which will save resources and time, and others. The aim of this publication is to investigate the main theoretical and practical aspects of virtualization of organizations, in particular, the impact of VR-technologies on their competitiveness, to analyze foreign experience in the use of virtual technologies in business and to summarize proposals for competitive advantage based on virtual reality technologies.

Key words: Virtual reality, augmented reality, digitalization trends, VR-technologies, BTL-marketing, 2 GR, USDZ.

JEL Classification: M11, G14, L86, O33

Introduction

In today's dynamic business environment, any business organization strives to maintain its own competitive advantage in the market. Therefore, each company develops and implements methods that allow not only to maintain a stable position, but also to develop and increase the scale of activities in a particular area. Such methods include various innovative solutions, attraction of highly qualified personnel, improvement of management system, changes in technological processes in production and many other things. Recently, however, so-called virtual reality technologies (VR-technologies) have become increasingly popular among companies. They are becoming increasingly important due to the rapid development of information and communication and digital technologies, which greatly facilitate and diversify the lives of most people and organizations.

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Virtual reality technology is slowly entering the workplace and is used in many fields such as medicine, construction and design, automotive, military, logistics, architecture and design, education, sports, engineering, design, tourism, and more.

The main advantage of such technologies is the possibility of complete immersion into the created reality, additionally acquired ability to feel and analyze both positive aspects and negative consequences of planned actions, as well as to simulate options for future events.

Therefore, the use of modern VR technologies by more and more organizations plays an important role in the development of their competitiveness. According to scientists and practitioners, the benefits of using such technologies are, first, to create added value for consumers through a new set of skills and knowledge; second, to give the organization a virtual competitive advantage; third, the achievement by the company of greater flexibility, dynamism and persuasiveness when using virtual reality to demonstrate its product (for example, to disassemble and assemble its own products in order to explain the internal mechanism or something else); fourth, reducing the duration of the production process, which uses VR technology; fifth, reducing costs and increasing profits for the organization by optimizing processes, which will save resources and time, and others.

1. Methodology of research

According to Gartner analysts, the widespread use of virtual reality technology can be talked about very soon, because technologically everything is ready for their mass application.

To back it up, a report from consulting firm PwC claims that the global virtual and augmented reality industry was worth $46 billion in 2019, and that it will increase 30-fold to $1.5 trillion by 2030.

Terminologically, virtual reality is a computer-generated three-dimensional environment with which a person can interact. Augmented reality refers to all projects aimed at supplementing reality with some virtual elements. Their principal difference is that virtual reality constructs a new artificial world, while augmented reality only introduces certain artificial elements into the perception of the real world. In the near future, such technologies will become a common part of everyday life.

However, today, the significant spread of VR-technology is still hampered, first, by the low quality of VR-content; second, by the variety of platforms and lack of uniform standards in its creation; third, by the absence of a clear distribution system, a single platform, where the relevant products would be collected. On the other hand, the dynamics of changes in the external environment of organizations and growing market competition leave them no choice but to quickly master new potentially valuable for consumers and profitable for the organization itself technologies that can improve its competitiveness. Using the capabilities of such VR-technologies will allow the organization to act proactively in a dynamic environment, create a significant competitive advantage, increase the current effectiveness of the organization and strengthen the dynamics of its adaptation to changes in the external environment.

The beginning of attempts to develop new devices can be considered the events of 2010–2013, when it was announced the development of special glasses Google Glass by Google and virtual reality helmet Oculus Rift by the same company.

Later they were joined by global companies such as HTC with its HTC Vive device, as well as Samsung, Sony, and Microsoft with their HoloLens develop-ments. There were also previously unknown developers who quickly raised funds for startups with startups.

Given the trends in the development of virtual reality, in the next few years there will be a breakthrough in information technology around the world, including Ukraine, which may become a new stage in the development of the information world, because the scope of such technologies is limited and more practical than modern desktops and laptops. According to experts and publications such as Greenlight VR, they will need another 10-15 years to make something similar to a revolution in information technology.

The results of the application of virtual reality are already tangible today. They encompass a wide variety of economic spheres: services, industry, entertainment, construction, and advertising. With the help of programs for these devices, companies will be able to increase the productivity of their employees, facilitate the learning process through the use of cues, the characteristics of the object with which one is working, and so on.

For example, the use of such technology in mechanical engineering and construction, where drawings and sketches will be replaced by augmented reality. This will facilitate work both at the construction site and when communicating with the customer. Prototypes of such programs have already appeared.

The development of virtual and augmented reality plays an important role in the field of design. The image can be superimposed on the real picture, so the client can be shown the design of any object, and it does not matter whether it will be an apartment after renovation, a dress, a car showroom, or any other object that can be designed.

A similar use is possible in travel agencies to show the best places of an upcoming trip and give the client the opportunity to see with their own eyes the scenery they will see on their future trip.

Although then the trip may not be necessary. It is somewhat more difficult to consider virtual and augmented reality devices as consumer products. Today, due to weak advertising campaigns, high costs, and imperfect devices, people do not buy goods on the scale that the manufacturers hoped for.

A preliminary analysis of the scientific literature indicates the relevance of the topic chosen for the study, because in a similar context, the use of VR-technology in Ukraine has not been conducted.

The first explorations of phenomena close to the modern understanding of virtual reality were carried out about 200 years ago. At that time, such searches were conducted for the sake of curiosity and entertainment. A prototype virtual reality helmet was first created for this purpose in the XIX century. Since then, research into its benefits and its use in the activities of organizations in various fields has only intensified. Researchers and business practitioners began to talk more actively about the use of virtual reality technologies in organizations in the mid-1980s, after the invention of the term "virtual reality" by American scientist Jaron Lanier and his desire to attract the attention of a mass audience to the new phenomenon (Virtual reality history from the 19th century to the present). The weight gain and spread of the idea of virtual reality took place after the release of the film "The Matrix" in 1999. However, the "industrial" application of VR technology began in 2012 with the creation of a mass production company for virtual reality equipment called Oculus VR. Two years later, as a promising technological innovation, the company was acquired by Facebook for two billion dollars.

Modern studies of virtual reality in Ukraine mainly deal with the problems of virtual education, the use of VR-technology in interior design, bridge construction, construction, engineering and other areas. Some authors cite the benefits of using virtual reality technologies in medicine, corporate education, automotive industry, digital marketing, shipbuilding, etc.

Given the rapid development of virtual reality technologies, the growth in the number and quality of VR devices appearing in the technological market, we should expect that the number of business models using them will grow. Therefore, the paper considers it necessary to find out the impact of VR technologies on the formation of organizational competitiveness and assess their importance in creating a competitive advantage.

Objectives of the article. The aim of this publication is to investigate the main theoretical and practical aspects of virtualization of organizations, in particular, the impact of VR-technologies on their competitiveness, to analyze foreign experience in the use of virtual technologies in business and to summarize proposals for competitive advantage based on virtual reality technologies.

2. Results and discussion

2.1. Areas and opportunities for the implementation of VR-technology in business

In today's environment of dynamic development of information systems (IS) and innovative technologies to improve the competitiveness of a business organization must develop an action strategy that will fully meet most stakeholder needs.

Above all, customers, partners, consumers, suppliers, etc. This is possible with the help of modern technology.
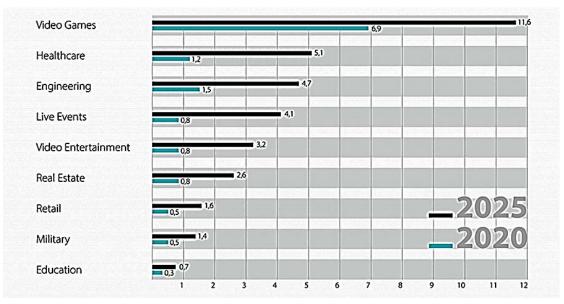

Figure 1. AR in Nubers by Segment AR/VR market

A diagnosis of global business practices in recent years allows to conclude that the main stakeholders of the organization have a growing interest in its effective and efficient operation.

A powerful stimulus for the search for ideas and the use of innovative technologies in the business processes of an organization is its competitors, who facilitate such a search and make its continued success possible.

Many foreign leading companies, seeking to ensure a better competitive position, attract innovative technologies to their business models. In recent years, VR-technologies have gained considerable popularity. Virtual reality simulates both the impact on the user through his or her senses (vision, hearing, touch, etc.) and the reaction to such impact. To create a convincing set of reality experiences, a computer-generated synthesis of virtual reality properties and reactions is performed in real time. For example, VR can be used to put important information directly on the windshield of a car whose driver has a busy delivery order schedule. Despite the portability of the car, the driver can see alternate routes, road closures and road complications.

The peculiarity of VR is their ability to combine a real environment with an imaginary one or one created with the help of a number of technical means. For example, the famous Google Corporation has developed a program that allows users to visit free online/offline tours of the Palace of Versailles. With the help of glasses or a helmet offline, users have the opportunity to visit twenty-one rooms of the palace, to get acquainted with ten sculptures and other works of art. If there is no possibility to use virtual technology, the corporation offers an online exhibition, which will allow to view 390 paintings and artifacts. An interesting fact is that 132,000 photos of the palace were used to create the virtual tour (Lutsenko, 2019). This example illustrates the effectiveness of VR and proves the usefulness and competitiveness of the use of VR technology in tourism and, in general, as an innovative solution.

Researchers who study the experience of using virtual reality technologies emphasize the possibility of using certain devices to fully immerse yourself in a virtual world, while isolating yourself from the real world. Today, there are certain tools that help everyone try new VR technologies:
– VR glasses and helmets are small screens that are placed in front of your eyes, thanks to their components, allow you to display objects in three-dimensional space. Additional features are that such equipment can include headphones, accelerometers, and other accessories;
– virtual reality rooms – a specific space in a physical room, on the walls of which photo or video materials are broadcast;
– virtual reality gloves are a hand device that can be used to perform certain manipulations through gestures with virtual objects.

At the current stage of virtual reality development, scientists argue about the rapid evolution of both VR technologies and VR devices (complete and autonomous devices such as smartphones, laptops, TVs, etc.), which often change the corporate culture and business etiquette of the organizations that use them.

As a result, an increasing number of customers, partners and other organizational stakeholders are leveraging virtual innovation and creating a foundation for competitive advantage based on VR ideas. In recent years, more and more areas of business have joined the use of the VR environment, as evidenced by the following list:
– Learning: Teachers can use virtual reality to interact with various objects in three-dimensional space. For example, when learning about the solar system, children can not just look at pictures in a textbook, but really immerse themselves in space thanks to a virtual reality helmet. Lenovo and Google have developed more than 700 virtual tours that can take students anywhere in the world, from the depths of the ocean to the most famous museums in Europe (Antoniuk, 2020).
– Medicine: Belgian doctors conducted a study and found that virtual technology can be used in surgery instead of taking various sedatives. The doctors call this technique "virtual hypnosis. The peculiarity is that during surgery the patient is put on headphones and VR glasses and turns on a soothing video about the life of underwater animals with commentary during the broadcast by a pleasant soothing voice (Proskuriakov, 2021).
– Mechanical engineering: Ford Motor Company uses VR projects during the design phase of vehicles. The company's design center, located in Cologne, Germany, has an equipped studio where design engineers can comprehensively evaluate a car without having a physical prototype. This equipment allows them to work faster and more efficiently on the layout and appearance of the car, as well as detailing the trim elements. Working in a studio like this, the company's designers were able to choose the optimal layout for the dashboard, seats, and controls for the new Ford Fiesta (IT-Enterprise).
– Sales: IKEA used virtual technology to develop its own catalogs. The method is quite simple: a person downloads the app, puts the catalog with the selected page in the place where he wants to place the goods, brings the phone camera up to the catalog and observes how the furniture will look in a certain place – according to their real size and proportions (Ochkova, 2016).
– Military sphere: since 2012, the U.S. has been training personnel using the latest technology. During the training of pilots, infantry, and military medics VR-technologies are actively used, which allow soldiers to be in conditions as close to combat as possible without any danger to life and health (Ochkova, 2016).

There are other areas of activity where virtual technology is less common, but used.

Table 1

The use of VR-technologies in different areas of business (Ezhikov, 2017)

Branch	Functional areas of activity		
	Advertising	BTL1 and sales	Business-communications
Industry	Demonstration for investors and GR2	Demonstration of equipment and the process at exhibitions and negotiations	Design, digital duplicates of technological chains
Real estate	View apartments online, direct advertising	Real estate shows at trade shows	Decision making in design and construction
Fashion and sports	Online broadcasts of fashion shows, sports and entertainment events (including paid events)	Gives you the opportunity to become a real participant in a particular event and experience real emotions	Training of athletes
Financial sector	Demonstration for investors and GR2	Design, digital duplicates of technological chains	Jobs for analysts and traders, data visualization

BTL is a type of marketing communication that is aimed at a narrow target audience of TV for a specific consumer.

2 GR (Government Relations) – the activities of specially authorized employees of large commercial organizations that interact with government agencies.

Generalized information about the feasibility of using virtual technologies in other areas of business is shown in Table 1.

These examples show the positive and growing experience of using VR technologies in business processes of foreign companies, which explains their creation of competitive technological and innovative advantages.

Business experts also attest to the growing use of VR in internal business communications and corporate training in recent years, as well as the use of VR by companies for trade shows and physical sales offices. Thus, VR technology is becoming a competitive standard for modern organizations.

2.2. Some examples of implementation

Consider both the GLB and the USDZ. These are compact, photorealistic file formats for 3D content created and adapted specifically for augmented reality. Certain formats are of paramount importance when it comes to viewing content online and on smartphones. Moreover, it is the USDZ that plays a crucial role when viewing content on Apple devices such as the iPhone and iPad. This is because the aforementioned files are a must if one wants to provide a seamless augmented reality experience that works across the board. Certain file formats define an object in terms of its appearance, mesh and materials. Both triangles and digital ink are part of the exoskeleton.

Here is an example. A kitchen table will act as a model, depicting a grid describing the shape of the table and the shape of the legs, as well as a material representing the appearance of the wood surface.

With industry-standard Physical Based Rendering (PBR) frameworks, materials are based on the perception of the real properties of light.

USDZ is an impartially brand-new file format for Apple devices. It was launched by the company along with Pixar in 2018. It is based on the USD format, which appeared much earlier. Nevertheless, innovative development is unique due to some distinctiveness. The USDZ invention for AR is genuine. After all, it is promptly available to plenty of users. A file from Photoshop or Dimension can be easily converted to the aforementioned format, and also launched on a smartphone or tablet.

Just as easy as sending a photo or an audio recording, users can now share 3D objects on the screen of their mobile device. After all, some objects have already become an integral part of the surrounding life. Despite this, Android-based smartphones do not support USDZE – and this is the only problem so far. It is noteworthy that even older operating systems, such as iOS 12, support these files. There is no way to open an image in augmented reality if the device cannot be updated. Nevertheless, even despite such limitations, the creation of the new file format means that soon we will have the opportunity to place any products from online stores in the space of a room, try them on and view them from different angles. USDZ represents a notable leap forward in both marketing and entertainment.

USDZ files' principal features

USDZ is an archive, but there is no need to extract files from it. Encryption or data compression does not apply to objects created in 3D graphics editors. When transferring information from one device to another, their quality remains unchanged.

The Pixar animation format is a generic description of a scene. The package of components for a complete 3D augmented reality object combined into a single file is the file of the same name, which exclusively has the ending "Z" attached to it. When trying to load an AR model, you can watch as applications bind to it. One click on the link or image is enough, and it launches. The format will become more user-friendly for the average user. Another feature that will catch the attention of developers is that the Adobe Creative Cloud suite of applications supports the new format.

Today, both commercial and non-commercial spheres widely use the aforementioned format. If it comes to sales, the purchase is often postponed because it is impossible to touch the item before buying it. This is especially true when selling luxury goods. "Trying on" living room furniture or understanding how a branded bag looks against the backdrop of your favorite sofa is made possible by the additional opportunity to interact with the product. As a rule, a customer prefers to shop at a company that has chosen this way of presenting goods, because emotions from digital contact are off the charts.

Many promising opportunities have opened up for artists with the transition to the USDZ format. This fact cannot be ignored. There is one reason that has long prevented 3D graphics from entering effective practice. The viewer cannot get full freedom of interaction using only photos and videos, and 3D graphics are not always available for all devices. In addition, augmented reality is now gaining in popularity. This is a key indicator that 3D artists will be able to develop their creative thinking more actively. Both scientific and industrial fields can also make use of USDZ files. Blueprints, crucial for architects and structural engineers, will finally become more accessible. In the educational field, interactive models help students and schoolchildren to learn knowledge correctly, as well as to expand their horizons. GLB is a 3D file format that outlines an object by its surface, both meshes and materials. In other words, it is an exoskeleton consisting of digital paints and triangles.

The simulated light reflects off the sample surface, just like real light reflects off a physical object. At the same time, an incredible effect is obtained on the screen, because it is combined with PBR (Physically Based Rendering) materials. Sharing? Why not, excellent! After all, it is available for viewing in 3D in all prevailing browsers and phones without the necessity to use optional applications.

This format stands for the Binary Transfer Format of the Web Graphics Library. This is a linked version of the .gltf format (base format). It often keeps textures joined with an external folder. The format growth is backed up by Google, Microsoft, Facebook, and Adobe, being founded by the Khronos Group. In brief, it is *Portable, * AR-ready, * Photorealistic

Conclusions

Based on the results of the study, the following conclusions are drawn.

Modern virtual and augmented reality technologies allow users not only to immerse themselves in a new environment for logistics, medical, travel, educational, industrial and other companies. At the same time, VR-technologies are a prerequisite and catalyst for future organizational transformations related to the creation of new competitive advantages. Researchers attribute an even more exciting experience to the future implementation of 5G technology, which will reduce latency between requests and responses by a factor of 10 and allow VR and AR applications to reach new levels of use.

Organizations need to closely monitor the development of modern ICT in order to use them in a way that provides a competitive advantage and improves the efficiency and effectiveness of their operations.

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