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USE OF 3D MODELING IN MODERN PRODUCTION

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Abstract:
The article examines the specifics of using 3D modeling technologies in modern production. The main areas of application for three-dimensional models are analyzed, including product design, engineering analysis, and prototyping. The advantages of digital modeling—reducing development time, increasing accuracy, and reducing costs—are highlighted. Research methods and technology development prospects will also be considered, including integration with additive technologies and automated production systems. It is shown that the implementation of 3D modeling is an important factor in increasing the competitiveness of enterprises in the digital economy.

Keywords: 3D modeling, manufacturing, CAD, digital technologies, engineering analysis, prototyping, 3D printing, additive technologies.

Аннотация:
В статье рассматриваются особенности применения технологий 3D-моделирования в современном производстве. Анализируются основные направления использования трёхмерных моделей, включая проектирование изделий, инженерный анализ и прототипирование. Особое внимание уделяется преимуществам цифрового моделирования, таким как сокращение сроков разработки, повышение точности и снижение затрат. Также рассматриваются методы исследования и перспективы развития технологии, включая интеграцию с аддитивными технологиями и

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автоматизированными производственными системами. Показано, что внедрение 3D-моделирования является важным фактором повышения конкурентоспособности предприятий в условиях цифровой экономики.

Ключевые слова: 3D-моделирование, производство, CAD, цифровые технологии, инженерный анализ, прототипирование, 3D printing, аддитивные технологии

Introduction

The modern stage of industrial development is characterized by the active implementation of digital technologies, which is fundamentally changing approaches to product design and production. One of the important tools of digitalization is 3D modeling, which allows for the creation of precise virtual copies of products, units, and technological processes.

As a result of the development of software tools such as AutoCAD, SolidWorks, and Blender, engineers have gained the opportunity not only to develop designs but also to conduct comprehensive testing in a virtual environment. This significantly reduces the probability of errors and increases the efficiency of engineering activities.

The relevance of the topic is linked to the desire of enterprises to increase production efficiency, reduce costs, and improve product quality. In the context of global competition, the use of modern digital tools is becoming an integral part of company success.

The purpose of this work is to analyze the features of applying 3D modeling in modern production, as well as to determine its advantages and development prospects.

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Main part. 1.3 Theoretical foundations of D-modeling. 3D modeling is the process of creating digital models of objects in three-dimensional space using specialized software. This process is based on an object.

• surface - forms the outer shell of the object;

• solid-state - represents the full volume of the object along with its physical properties.

The most common are solid-state models, which allow for the consideration of mass, density, strength, and other parameters necessary for engineering analysis. Furthermore, modern modeling systems support parametric design, where a change in a single parameter automatically affects the entire model. This significantly simplifies the process of making changes and optimizing the design.

2. Steps to creating a 3D model. The 3D model creation process consists of several sequential steps:

1. Creating geometry - constructing the shape of an object using basic elements;
2. Marking materials - determining physical and visual characteristics;
3. Visualization - obtaining a realistic image of the model;
4. Analysis — testing a model for strength, stability, and other characteristics.

Additionally, the stages of design optimization and model preparation for production can be performed.

In practice, the modeling process is iterative in nature: the developer repeatedly returns to previous stages to refine the model (Fig. 1).

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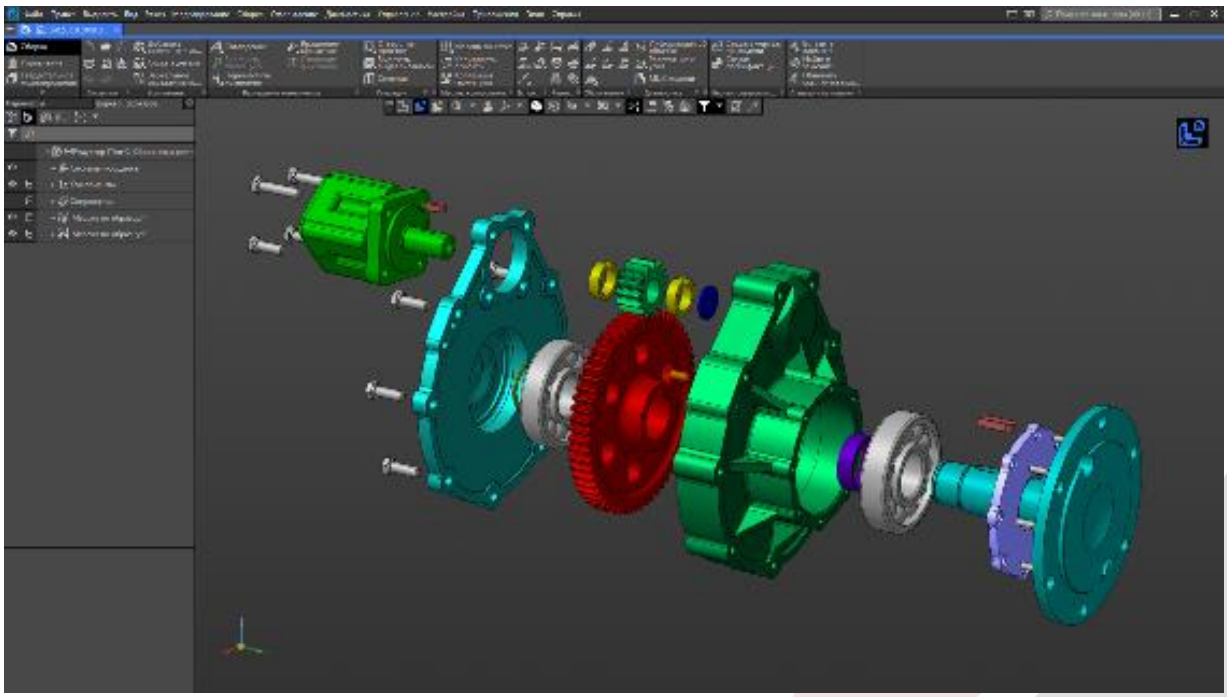

Figure 1 is an example of a 3D model of a part

3. Using 3D modeling in production

3D modeling is applied at almost all technical stages of the product:

- design;
- structural analysis;
- production preparation;
- production;
- quality control.

In mechanical engineering, this technology allows for the high-precision creation of complex mechanisms such as engines, gearboxes, and machine tools. In the construction industry, it is used for building visualization, load calculation, and infrastructure planning.

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In the aviation and automotive industries, 3D modeling is used to develop aerodynamic shapes and enhance product safety. In medicine, these technologies are used to create prostheses and plan surgical interventions.
Thus, the scope of application for 3D modeling is constantly expanding (Fig. 2).

4. Advantages of using technology. 3D modeling provides the following significant advantages:
• reducing the number of errors at the design stage;
• reducing product development time;
• reducing the cost of creating a prototype;
• the possibility of conducting virtual tests;
• improving product quality and reliability.
Most importantly, many errors can be detected before the start of actual production, which allows for the avoidance of expensive processing.

Figure 2 - Use of 3D modeling in production

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The level of cooperation between specialists will also increase: 3D models help to clearly show ideas and simplify communication between engineers, designers and customers.

5. Connection with modern technologies. 3D modeling is closely related to the following modern technologies:

- 3D printing (additive technologies);
- virtual and augmented reality;
- automated production control systems;
- digital twin technology.

The integration of these technologies allows for the creation of fully digital production processes, where all stages from design to finished products are integrated into a single system.

The concept of the "digital twin" is particularly important, as it involves creating a virtual copy of a real object and constantly updating it based on operational data.

6. Development prospects of 3D modeling. The prospects for the development of 3D modeling are linked to the further digitalization of the industry. The widespread implementation of artificial intelligence technologies is expected, which will allow for the automation of design and analysis processes.

Cloud modeling is also developing, providing access to powerful computing resources and the collaborative work of specialists from different countries.

Other prospects:

- increasing the realism of visualization;
- acceleration of calculations and simulations;
- integration with the Internet of Things (IoT);
- development of generative design.

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All of this contributes to the formation of a new industrial model based on digital technologies.

Research methods. The following methods were used in the work:
• analysis of scientific and educational literature;
• comparing traditional and digital production methods;
• systematization and classification of data;
• generalization of research results.
These methods made it possible to fully understand the role of 3D modeling in modern industry and identify its development trends.

Conclusions
3D modeling is one of the essential tools of modern industry, ensuring high precision, efficiency, and flexibility in production processes.
Its application significantly reduces product development time, reduces costs, and improves quality. Integration with other digital technologies creates new opportunities for automation and optimization of production.
In the future, 3D modeling will develop further and be deeply integrated with artificial intelligence, additive technologies, and digital twin systems. This will lead to the formation of fully digital production processes and the transition to the "smart production" concept.

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