

The creation of objects of the Kazakh culture with the use of additive technologies

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Abstract. The article presents material about the main prospects for the introduction and operation of new additive technology in the Republic of Kazakhstan. Additive technology (3D printing) is a global phenomenon that contributes to the development of new industries that use digital technologies. 3D printing is necessary for the production of quality products. Kazakhstan, the world's fifteenth largest gold producer, does not actively promote the jewellery industry. Jewellery is an obligatory attribute of a family celebration and an element of the national culture of Kazakhstan. Jewellery products purchased in Kazakhstan are only 10% local; all the rest are from Russia, Turkey and Europe. New production of jewellery products using three-dimensional modelling and additive technologies should become an image industry in Kazakhstan, due to exclusivity and affordable cost

1 The relevance of the research

The Development Strategy of Kazakhstan says that the development of the digital industry will provide a boost to all other industries. At the time, the head of state set a task to develop new industries that are created by using digital technologies [1]. Additive technology (3D printing or three-dimensional printing) is a global phenomenon. Currently the level of implementation of this technology is 41% in North America, 30% in Europe, 25% in Asia, and 4% in the rest of the world (ROW) [2]. North America is expected to fall to 37% of the 3D printer market in 2025, while Europe and China are expected to grow to 32% and 29%, respectively. The rest of the world will be at 2% [2]. This data indicates the relevance of the introduction of additive technologies in the industry of Kazakhstan.

It is also a well-known fact that Kazakhstan ranks fifteenth in the world in terms of gold reserves, fourth in terms of silver reserves, and second in the world in terms of gold content in ore [3]. Among the CIS countries, Kazakhstan is in the third place in proven gold deposits after Russia and Uzbekistan. According to experts, Kazakhstan has reserves of more than 10 thousand tons of gold [4].

In the Republic, almost half of all gold reserves are concentrated in the 8 largest deposits, of which two are located in the Akmola region – Vasilkovskoe and Zholymbet.

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At the same time, our country, being one of the world's gold owners, can only represent 10% of all jewelry products on the domestic market, while the remaining 90% come from countries that export finished jewelry, such as Russia and Turkey.

In General, gold has been rising in price for many years and is gradually becoming a luxury for the population. Currently, gold products are sold in the salons of Kazakhstan for twenty-two thousand tenge per gram. But taking into account permanent discounts, the final price is seventeen thousand tenge per gram [5].

At the same time, for the peoples of Asia and Kazakhstan, jewelry is a mandatory attribute of a family celebration and an element of national culture. This once again confirms the relevance of the introduction of new technologies that will not only reduce the cost of manufacturing jewelry, but also revive the native Kazakh folk motifs, patterns and ornaments.

The new production of jewelry using three-dimensional modeling should become the image industry of Kazakhstan, due to exclusivity and affordable cost.

As is known from history, it is customary to make jewelry either by hand or by casting. Three-dimensional modeling allows you to visualize any desire of the client, and three-dimensional printing allows you to get an absolutely accurate model of the jewelry [6]. The main arguments for the introduction of additive technologies in jewelry production include the following advantages:

- reduction of manufacturing costs;
- High delivery speed;
- saving precious metals;
- new design features;
- getting absolutely exclusive products.

In addition, the use of new technology allows to create very detailed elements of the smallest size and allows to adjust a 3D file. This means that there is no need to cast a precious metal product to assess its conformity with the desired pattern. In this case the plastic prototype is replaced, which saves expensive materials and time [7].

If we talk about trends in research on additive technologies, it should be noted that the United States has the largest number of publications, and China is the leader in the number of sales of machines working on additive technologies. The very first scientific publications were German articles, and the amount of research funding in Europe is ahead of England. The leading organizations in the world that work with additive manufacturing are: 7 organizations from the US, 4 from China, 3 from the UK, 2 from Germany, 2 from Australia, 1 from Singapore and 1 from Belgium. All these facts indicate the prospects of this technology, which means that Kazakhstan should be interested in implementing additive technology in the production of new products [8].

2 Review of the relevant state

Funding for research on additive technologies increases annually, for example, in the EU, additive technologies are clearly a priority area with invested funding of 160 million euros [9].

A review of studies of the English universities:

The University of Nottingham has the highest registered funding, equipment and publications. The university has several unique machines and its research interest is widespread on various topics, with a slight focus on the use of new materials in three-dimensional printing.

Cambridge University has the widest range of equipment available and some exclusive prototyping machines are presented in publications. The main research area is the creation of new methods of layer-by-layer synthesis.

The University of Sheffield's research in AM focuses on the development of materials, as well as new software applications and processes.

The University of Loughborough is another leading university whose funding doubled in 2015 and 2016. AM was intensively used as a tool to produce products during research,.

So far, University College of California, London has been the fastest-growing university, with a four-fold increase in funding received in 2015 and 2016. Currently, it is more focused on developing software applications and creating new materials for additive technologies.

A report on additive technologies by Imperial College London says: "Research on additive technologies in the UK is weak in the areas of regulation, design, economic and environmental assessment, which may be the key to expanding AM research and lead to the commercialization of this technology" [10].

Analysis of external sources suggests that there are common global trends in the development of additive technologies:

- It is positive that this technology is the future, everyone agrees and most invest in research tools to uncover the true potential of the technology

- Negatively, the pace of commercialization of this technology is low.

MIT has had a significant impact on the AM industry, mainly through its innovative research projects. In particular, MIT has also launched a new 11-week online course, which may become one of the most important initiatives for professionals who are interested in AM around the world. IDTechEx forecasts that by 2029, the global market for 3D printing equipment, materials, software and services is estimated at \$ 31 billion [11].

Analysis of the situation with the introduction of additive technologies has shown the following weaknesses in the development of new technologies in Kazakhstan:

- Lack of a clear understanding of the equipment and its purpose, leading to its inefficient use;

- Non-professional service;

- Lack of technical support.

Quality counselling is not available due to the lack of highly qualified specialists. The main threat to the transfer of new technologies to Kazakhstan is human potential.

In Kazakhstan, the introduction of additive technologies in industrial production requires specialists with fundamental knowledge based on scientific principles. We need a single center, equipped workshops and laboratories for the acquisition of skills in three-dimensional printing, and, in general, a new specialty in higher education.

Implementation and solution of the project tasks will allow us to get closer to the commercialization of additive technologies in Kazakhstan, which means keeping up with world leaders.

3 Results

Industrialization is defined as the flagship of the introduction of new technologies in the annual message of the Head of State to the people of Kazakhstan «New opportunities for development in the Fourth Industrial Revolution» One of the vital conditions for successful competition in the global market of enterprises in the extractive and manufacturing sectors is innovation, which allows using all the advantages of the new technological order 4.0 [12].

As a result of research and creation of a mathematical model of the process of obtaining products using additive technology, the list of products and services of the Akmola region can be expanded. As a result, the volume of products produced on foundry equipment will be increased and the cost of obtaining cast parts for burned-out models will be reduced. The value of the economic effect can be calculated accurately. According to preliminary

forecasts, the use of additive technologies in jewelry production will be profitable and will pay for itself in less than 1.5 years.

- The implementation of the project can contribute to the creation of new jobs, the functioning of the design and three-dimensional modeling Center for Business Representatives, or the opening of an accredited production and scientific laboratory on the basis of the Abay Myrzakhmetov Kokshetau University.

- The publishing of a textbook "Technology of layer-by-layer synthesis" on additive technologies for future technical specialties, and how to write guidelines for conducting research and development using 3D printing. The author's certificate "Mathematical model of additive process of obtaining foundry equipment" will be issued later.

- 2 monographs will also be written and published: "Methods for calculating and selecting the main parameters for obtaining three-dimensional models using additive technology" and "Methods for designing new tooling structures for casting jewelry".

- There will also be a collection of material for writing and defending 4 master's and at least 6 bachelor studies.

- The submission of documents for obtaining a patent for a utility model and an author's certificate "Mathematical model of the additive process of obtaining foundry equipment" is planned.

- It is planned to register intellectual property at the end of the work, conclude agreements on joint research and production activities, and expand the scope of activities and accreditation of the existing laboratory of three-dimensional modeling at Abay Myrzakhmetov Kokshetau University.

- Providing the existing and purchased equipment for general use will allow a large number of people with creative inclinations to join in the creation of new products, speed up the implementation of research and development work and, most importantly, create a new environment and conditions for the innovative development of the region.

- Holding planned events in the style of round tables and training seminars will help to spread new knowledge and skills in the field of innovative and information technologies among the general population and will engaged small and medium-sized businesses.

The possibility of high-quality development and implementation of new additive technologies in production and in the educational process will help boost the industrial and innovative development of Kazakhstan and allow young professionals to feel more confident in the international market.

4 Discussion

Over the past 10 years, additive technologies have advanced significantly in many industries: aerospace, automotive, medical, and even cooking. Penetration of the mass market has increased significantly, but has not yet peaked due to a number of technical issues such as printing speed, accuracy, tolerances, and production volumes. These problems open up wide opportunities for research at the stages of the three-dimensional printing process.

To achieve the project goal, it is necessary to solve consecutive tasks:

- 1 implementation of the completed initiative theme "Creating a design and three-dimensional modeling center": purchase and launch of equipment;

- 2 study the world's experience in the use and implementation of additive technologies in the production of new products;

- 3 do a theoretical study of the laws of additive technologies and the process of layer by layer synthesis;

- 4 performing experimental work to determine the dependence of print quality parameters on the properties of the original digital model;

5 development of methods for designing new tooling structures for casting using burnt models based on the research performed;

6 development of a new efficient process for obtaining technological equipment for the manufacture of new jewelry;

7 analysis of existing educational and methodological literature on the use of additive technologies in the jewelry industry;

8 creation of educational and methodological materials for new educational programs and manuals for small and medium-sized businesses when working with technological innovations.

The creation of a center for design and three-dimensional modeling will allow one to get new services for the region in three-dimensional modeling, creating prototypes and models of jewelry products in particular, as well as raising the image of traditional Kazakh folk art. In addition it is possible:

- To create unique models of future products of any complexity;
- To produce jewelry using exclusive three-dimensional models;
- To create one's own digital archive;
- To restore unique products.

The possibility of high-quality study, development and implementation of new additive technologies in production, and most importantly, in the educational process, will help to accelerate the industrial and innovative development of Kazakhstan and allow young professionals to feel more confident in the international market [13].

5 Conclusion

The significance of the project is to create a new area of technological knowledge of industrial production. In addition to economic efficiency, the project has a high social significance the creation of an educational and technological system for training specialists. This, in turn, will speed up the introduction of new technologies, increase the level of training of graduates of technical specialties and help them to successfully adapt to the global technological space.

The creation of the center, equipped with new technological equipment that has the most modern software for three-dimensional modeling, will have a positive effect on the ongoing social and economic processes in the region.

Furthermore, the specificity of the jewelry industry is explained by the term "jewelry accuracy" and the introduction of additive technologies in the production of new products allows one to implement this accuracy with minimal costs. The uniqueness of the proposed project is that digital three-dimensional modeling technologies that are already in service will allow the creation exclusive cultural Kazakh national products in precious metals and this can become a business card of the whole of Kazakhstan [14].

Additive technologies have great potential in reducing energy costs for the creation of a wide variety of products. Without specialists in this technology it will not happen in Kazakhstan.

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