Improving intellectual property management for organizations working in the field of additive manufacturing

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Abstract. The article is devoted to the problems that arise for state budget organizations in the management of intellectual property objects created in the field of additive manufacturing in the Russian Federation. The possibilities of their elimination by creating changes to the existing methodological documentation are considered. The paper examines the methodological documentation of leading universities on the creation of developments in the field of additive manufacturing in this country, and offers suggestions for its improvement.

1 Introduction

In the modern world, the role of intellectual property is increasingly increasing. It affects the development of not only individual companies, but also entire sectors of the economy of any country. For organizations working in the field of additive manufacturing, this makes the issue of management and its protection relevant (Neves et al., 2021, Duning et al., 2021, Dyachenko, 2022, Azgaldov et al., 2010). The functioning of the enterprise is impossible without high-quality management of intellectual property; it develops its innovative activities in the country and abroad. Azgaldov and Kostin (2010) argue that the management of an object, including intellectual property, is an activity that allows you to transfer an object from one state to a predetermined other state, in a given time period. The process of intellectual property management requires a policy to make specific management decisions based on it. It should also include an innovative model of an organization operating in the field of additive manufacturing (Gomez et al., 2016). Every year, the global (Altyparmak et al., 2021) and Russian (Teslenko et al., 2019) market of additive technologies increase in volume. At the same time, Russia loses up to 5% of GDP due to the poor quality of intellectual property management (Russian Union of Industrialists and Entrepreneurs 2022). Competition in the field of 3D printing services increased synchronously with the overall growth of the market, including in Russia. Equipment manufacturers and material manufacturing companies are constantly developing various directions for new applications of additive services. There is a need to protect the created intellectual property. Improving the efficiency of intellectual property management will positively affect the results of the economic activity of an organization working in the field of additive manufacturing. This will help to recoup the

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organization's funds invested in the development of technologies and equipment. The need for such an increase is also confirmed by the data of Rospatent. This is shown in Figure 1. The presented data testifying that the number of inventions patented annually, including in the field of additive manufacturing, in the Russian Federation is increasing. At the same time, only a small part of it is commercialized by disposal contracts.

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Fig. 1. Number of patents for which exclusivity dispositions have been registered by treaty.

The author based on data from the patent database of the company Questel (Informational website Questel 2022) built the dynamics of patenting in the field of additive manufacturing in Russia. It shows that in recent years there has been a slight decline in activity due to the withdrawal from the market of a number of companies that patented technical solutions in it. This is caused by COVID and sanctions restrictions. This is shown in Figure 2.

Fig. 2. Patenting dynamics in the field of additive manufacturing in Russia.

In 2021, the Government of the Russian Federation supported the Strategy for the Development of Additive Technologies until 2030 (The Government 2021), which allows us to hope for a change in the situation for the better. This will allow domestic developers of technical solutions in this area to receive additional funding for their research, and will cause a new surge in patenting activity. In addition, a positive moment for the development of the market is the reorientation of domestic equipment developers from using components from the USA and Germany, which are world market leaders and dictated their “tough” conditions, to suppliers from Asian countries, for example, from China. In recent years, China has been actively increasing sales of its laser equipment used, including in complexes for additive manufacturing. A plus for the market is the development of Russian laser equipment, for
example, by the state corporation “Rosatom” specifically for additive manufacturing and especially for selective laser melting (Informational website Metal-am.com).

The majority of developers in the field of additive manufacturing in Russia are state budget organizations, technical universities that either do not fully or do not effectively use their existing scientific potential and technical solutions protected by patent law. The main problem of technical universities is that they use their knowledge, experience and qualifications of personnel, reputation in the field of additive manufacturing as auxiliary resources, haphazardly and irrationally interact with competitors and potential partners. At this time, the guidance (methodological) documentation on intellectual property management available to them is not taken into account. This is largely because it does not take into account the specifics of the results of intellectual activity created in this area. All this led to the need to improve it. Both Russian and foreign scientists were engaged in the organization of management, including accounting and commercialization of intangible assets. Most of the studies were carried out for the developed technology market and the existing Western legislation, without taking into account the characteristic features of technical solutions in the field of additive manufacturing and management systems in the field of intellectual property existing at Russian enterprises operating in this field. The above facts predetermined the purpose of the study. It consists in identifying the problems associated with the low efficiency of intellectual property management and proposing changes to existing methodological documents to improve it. The focus of the study was on state budget organizations (universities) are leaders in the development of technical solutions in the above-mentioned area in Russia.

2 Materials and methods

Methodological documents on intellectual property management of Bauman Moscow State Technical University, Peter the Great St. Petersburg Polytechnic University, Tomsk Polytechnic University, St. Petersburg State Marine Technical University (SPbSMTU) were used as the main sources of information. Descriptive and aggregated approaches to the analysis of methodological documentation were used to achieve the purpose of the study. The main methodological documents adopted by the management of universities aimed at the management of intellectual property can be divided into categories according to Figure 3.

![Fig. 3. The main documents adopted by the management of universities on methodological support of intellectual property management.](image)
3 Results and discussions

In the course of the work, problems were identified that do not allow universities to receive significant economic benefits from their intellectual property in the field of additive manufacturing. Among them are:

- Lack of methodological documentation on the management of intellectual property objects, taking into account the peculiarities and obsolescence of technical solutions in the field of additive manufacturing.
- Authors-developers often do not report the creation of the result of intellectual activity.
- The results of intellectual activity created in this area are not initially commercially attractive to potential buyers (licensees).
- Inventions and utility models are patented due to contractual obligations and are valued below the actual possible value on the market.
- Intellectual property licenses are issued for a song and only non-exclusive.
- Long deadlines for the conclusion and registration of license agreements.
- Lack of funding from management to train employees in the field of additive technologies.

In most universities, a situational approach to the process of managing intellectual property objects is most often used in practice. It consists in assessing the specific situation by the responsible departments and the management of the organization, taking concrete measures for the effective management of objects at certain stages of the life cycle of these objects.

At the same time, the existing documents do not focus on the specifics of the additive manufacturing market. It also turned out that the entire list of methodological documents has not been implemented in any of the universities. To improve the efficiency of the intellectual property management system, the author suggests using the principles based on the process-functional approach of managing intellectual property objects throughout their life cycle. For this purpose, changes were developed to the existing methodological documents on intellectual property management adopted by the management of universities. Methodological documents that could be used to implement a functional approach involving management at all stages of the life cycle should make it possible to increase the efficiency of management at each stage and take into account the specifics of the results created using digitalization tools.

These documents include provisions on the University's divisions dealing with intellectual property. It should contain sections related to the need to improve the skills of employees of these departments in the direction of additive manufacturing. This will make it possible to better identify and ensure legal protection of the results obtained by digital tools. For example, three-dimensional models used to compile a work program for additive manufacturing; a possible protection option for them is protection in the form of programs or inventions. To begin actions to ensure the protection of the result of intellectual activity, based on the provisions on intellectual property adopted in most universities, the author must provide a written form of notification of the disclosure of the result of intellectual activity. It is usually provided in printed form. At the same time, the form does not allow taking into account technical solutions that are associated with a three-dimensional model or an algorithm for dividing the model into layers, as well as a way to create a trajectory for a working tool for layer-by-layer product creation. It is often difficult for authors to describe these technical solutions in the form of a text applicable for future writing of a patent application. This leads to the fact that the authors do not notify the intellectual property management units about such decisions, making their work easier and depriving universities of potentially profitable intellectual property objects.
The best way out of this situation is the introduction of an electronic form of notification of the creation of the result of intellectual activity and the addition of the ability to attach 3D models of grown products. In these forms, it will be possible to depict various schemes of layering and the movement of the working tool relative to them. The addition to the regulations on the activities of the Intellectual property Management Department of the University of the obligation for the employees of this department to use a single electronic system of accounting for intellectual property objects and created models will speed up and simplify the decision-making process on further patenting or keeping this information secret. This system should be connected to the electronic resources of the accounting department. This will increase the speed of interaction with this department.

Methodological documentation should include regulations that help to select among the results of intellectual activity those that can be commercialized. To do this, there must be regulations that allow you to plan in advance the results of intellectual activity for creation, taking into account their future place in the market and application in a high-tech product (specialized software, a set of equipment, technology for growing and post-processing the product). Such planning will be made possible by introducing into the regulations on the management of intellectual property rights the obligation of the intellectual property management department to conduct regular patent and marketing research based on patent information and using patent analytics methods. Such research in Russian universities, especially in this field, is practically not carried out, unlike foreign companies that, in order to plan their developments, order such research to analytical companies (one of the most famous, specializing in Wohler’s Associates, which issues an annual report on the situation on the world market).

These changes in the documents will make it possible to plan the creation of relevant results of intellectual activity even before the start of various scientific research and design work. Such results will be potentially commercially profitable, and research will help to remove obsolete solutions from circulation that are on the balance sheet in the form of intangible assets even before the planned inventory procedure. The documents should take into account the current trends in the development of additive technologies in the market, identify priority areas and take into account the optimal lifetime of one technical solution in it. It is no more than 3-5 years, which allows us to conclude that it is necessary to conduct such studies at least once every three years. The created results of intellectual activity, for successful future commercialization, must contain the solution of problems in a specific area of industry. Therefore, it is necessary to add a section to the regulations on the management of rights to the results of intellectual activity that intellectual property objects in the field of additive manufacturing should be associated with the priority direction of the organization's activities, for example, shipbuilding.

In the job descriptions of the heads of structural divisions, it is necessary to introduce an obligation for managers to coordinate with the intellectual property management department a list of the results of intellectual activity planned for creation and the method of their legal protection and further commercialization. Managers should prepare a brief summary report on the results of scientific research for the quarter. This will allow the Intellectual property management department to increase control over the creation of the results of intellectual activity, adjust the choice of the optimal form of legal protection, as well as reduce the risk of disclosure of patentable information before filing a patent application.

Universities also do not have clear methodological documents that disclose the procedure for monitoring the market for violations of its exclusive intellectual property rights in the field of additive manufacturing. If a violation is detected in the available documents, there is no clear sequence of actions that the responsible department should take. To improve the efficiency of the intellectual property management system, it is required to introduce the obligation to participate in regular multi-level training seminars on the basics of additive
manufacturing for employees of intellectual property management departments and in the field of intellectual property for engineering and technical personnel in the regulations on employee training and their job descriptions. This will help in identifying new solutions, increase their value in the market, and allow these groups of students to jointly take an active part in the process of managing intellectual property objects created in the field of additive manufacturing at the main stages of their life cycle from planning to commercialization.

For different categories of employees of departments of these organizations, the frequency and content of training courses in the field of intellectual property should be different. At the same time, it is necessary that the maximum period between the two courses does not exceed two years. This is due to the fact that changes or amendments to legislative documents, rules or even the Civil Code of Russia in the part regulating activities in the field of intellectual property have been made almost annually in Russia. When developing a course program on intellectual property, the job responsibilities of employees should be taken into account. The program should involve the allocation of separate levels of training, as well as the division of trained employees into groups based on their current knowledge and emerging needs. To do this, you can use assessment questionnaires with questions and small test tasks in order to determine the current level of the future student.

To consolidate the acquired knowledge at the end of training, certification should be carried out. Upon successful completion, a certificate of completion of advanced training courses must be issued. Methodological documents on intellectual property management of the SPbSMTU is one of the leaders in the field of additive manufacturing in Russia, were studied in more detail.

The scheme of interaction of the department of patent and licensing work and information dealing with intellectual property management at this university with other departments, as well as with Federal Institute of Industrial Property (FIIP) as the receiving division of Rospatent, all patent applications, including in the field of additive manufacturing, were built on the basis of these documents. This is shown in Figure 4.

![Fig. 4 The scheme of interactions in SPbSMTU based on methodological documents for intellectual property management main documents adopted by the management of universities on methodological support of intellectual property management.](image-url)

Based on the analysis of the documents, it was revealed that they do not pay significant attention to the stage of planning and commercialization of the results of intellectual activity created in the field of additive manufacturing. They also do not take into account the technical features of these solutions created in the field of additive manufacturing, in particular, rapid obsolescence and linking the results of intellectual activity to software used for remote creation of control programs for deposition of products.
In the course of the study, it turned out that this University does not have an adopted policy in the field of intellectual property, which could link and combine the various stages of intellectual property management regulated by separate methodological documents, as is customary in leading universities in Russia. At the moment, it is under development. The University does not have regulations on the management of intellectual property rights and a unified strategy for the protection of intellectual property results for the entire organization. This led to the need for a search and a separate study of methodological documents from the list given earlier. As a result, of the research, it turned out that in the budgetary organization, the work related to intellectual property is mainly carried out by the department of patent and licensing work and information, whose activities are largely determined by the regulations adopted in 2019.

No guidance documents have been identified for this department that would help it encourage employees of university departments to create commercially attractive results of intellectual activity within the framework of research and development work related to additive manufacturing. In order for this department to be able to participate in the management of intellectual property objects.

At the moment, one of the three leading divisions of the University that bring significant income is the Institute of Laser and Welding Technologies. His main activity in recent years has been conducting research and developing technical solutions related to additive technologies in shipbuilding. Unfortunately, the other departments of the University are not well aware of the subtleties of these methods, especially in relation to shipbuilding products. In order to reduce the gap in knowledge on additive manufacturing between university departments and increase the efficiency of identifying solutions capable of legal protection in the field of additive technologies, as well as timely profit from the results of intellectual activity created, it is necessary to regularly conduct training seminars, which were mentioned earlier.

Encouraging employees to create the results of intellectual activity in the field of additive manufacturing, capable of legal protection, should be spelled out in the rights section of the job description of employees of divisions. It should be indicated that the author will be paid remuneration at the discretion of his supervisor in accordance with the current regulations on incentive payments, but not less than 5% of the employee's salary. To make a decision, the head of the structural unit should be guided by the indicators of the effectiveness of intellectual property management. Among them are the number of patents supported by the organization in this area, the coefficient of use of patents from the field of additive manufacturing for its own production or for commercialization, the number of alienations and licenses issued per year for them, the amount of income that intellectual property objects have brought and the number of patented technical solutions in the field of additive manufacturing per year. Their values should be approved annually by the Vice-Rector for Scientific Work on the basis of the tasks for the commercialization of intellectual property set within the framework of priority areas of development and in the University policy itself. If the technical solution proposed by the employee, according to the forecasts of the employees of the patent and licensing work and information department together with the marketing department, will increase these indicators, and at the same time allows you to hope for commercial benefits, then the amount of remuneration can be increased in proportion to the categories specified in the regulations on incentive payments and not exceed the employee's salary.

The regulations on the management of rights to the results of intellectual activity should prescribe an algorithm for making a request and sending it for submission for remuneration according to the order of the Vice-Rector for Scientific Work of the corresponding authors of the results of intellectual activity. In the existing regulations on know-how at the University, there are no regulatory actions for the protection of such objects specific to
additive manufacturing as developed algorithms for controlling the 3D printing process, databases of 3D printing modes of products or equipment preparation before or after the end of the process, which are created in special software and may constitute a trade secret, but the negligence was transferred to third parties, not having at that time the status of materials constituting a production secret. It is proposed to introduce into the form of notification of the creation of the result of intellectual activity a section related to the wish of the head of the structural unit from whom the notification of granting or not granting legal protection to this data in the know-how mode has come, and in the regulations on the management of rights to the results of intellectual activity there should be a clause that for the case of granting the protection regime in the form of know-how with the authors, in addition to the non-disclosure agreement, an additional non-competition agreement is concluded with the university from the region, to which the know-how materials are related in order to protect against possible actions of competitors to develop a similar solution with their help.

To increase the automation of record keeping for applications related to additive manufacturing, the author proposes to introduce an electronic unified accounting system at the university. It should allow you to see the status, the current content of the application documents, and the employee of the department associated with the management of intellectual property should be able to make corrections to the application documents. It is necessary to provide limited open access to it for the heads of various structural divisions. This would allow them to be better informed about the names of the solutions being created and, if necessary, send requests to this department for more detailed information on them. Also, limited access to the register of intellectual property objects protected by patent and copyright belonging to the University should be provided to each employee registered by the intellectual property management department. This would make it possible to better prepare materials for technical reports, presentations, prepare requests for organizing events to provide licenses for missing solutions for their activities. Such a database should be connected to the resources of the accounting department to optimize and reduce the timing of the balance sheet after making appropriate decisions. The introduction of such a relationship should be prescribed in the governing documents related to the work of the accounting department and in the regulations on the activities of the department dealing with intellectual property management.

4 Conclusions

As a result of the research, it turned out that in order to improve the efficiency of the intellectual property management system, it is necessary:

• it is proposed to introduce an Intellectual Property Management Policy linking the management of intellectual property objects at all stages of the life cycle;
• conduct regular patent research and marketing research of the additive manufacturing market based on patent information and using the patent analytics method to identify market trends and patentable niches.
• oblige the intellectual property management department to use a unified automated system for accounting for intellectual property objects and created models connected to electronic accounting resources.
• conduct regular multi-level training seminars on the basics of additive manufacturing for employees of the Intellectual property management Department and on the basics of intellectual property for engineering and technical personnel.
• to fix in methodological documents the connection of the intellectual property management system with the features of technical solutions in the field of additive manufacturing and the main industry in which the organization operates,
• add a section on the mandatory signing of a non-disclosure agreement with the authors of the know-how and a non-competition agreement with the university.
• to oblige the heads of structural divisions to coordinate with the intellectual property management department the list of the results of intellectual activity planned for creation, the method of their legal protection and further commercialization.

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