Service to stimulate the student’s inventive activity at the university

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Abstract. The relevance of the topic of the article is due to the need to intensify innovation at domestic industrial enterprises to ensure accelerated technological sovereignty. The article presents the justification for the need to develop a university service to automate the process of generating a patent application, as an important component of inventive activity. The analysis of existing foreign software products for the formation and verification of applications showed that they cannot be used in domestic universities to obtain Russian patents. A step-by-step algorithm for the process of filing an application for a patent is formulated and an assessment is made of the possibilities of its automation using the service. For the possibility of developing a service to automate the process of generating applications, a description of its main functions is given (the presence of a line of application element templates; filling out a patent application form; assistance in compiling a description of an invention or utility model; support for multi-user work; integration with other systems; tracking the status of an application for grant of a patent, etc.). In addition, the qualification requirements for the service development team are structured in the form of the necessary knowledge, skills and practical experience. The main advantages of using the service for university students and other novice inventors are determined.

1 Introduction

One of the tasks of modern university training is, simultaneously with the formation of professional competence, which allows solving industrial and scientific problems, the formation of a number of universal competencies regulated by the Federal State Educational Standard of Higher Education (FSES HE). Such competencies are also defined in their own educational standards of universities, for example, in the educational standard of the Ural Federal University (UrFU) for undergraduate programs in the field of education "Engineering, technology and technical sciences" (UrFU educational standard for the development and implementation of undergraduate programs in education “Engineering, technologies” (approved by the UrFU Academic Council on November 26, 2018) (URL: https://urfu.ru/sveden/edustandarts):

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is able to carry out a critical analysis of problem situations based on a systematic approach, develop an action strategy, including in the digital environment;

- is able to determine the range of tasks within the set goal and choose the best ways to solve them, based on the current legal norms, available resources and restrictions, etc.

Attention should be paid to the similarity of the wording of these competencies in the federal state educational standards for various areas of training, for example, construction (08.03.01); radio engineering (11.03.01), etc. Due to the complex content of such competencies, their full-fledged formation will be conditioned by the need for the student to solve not only traditional educational tasks (tasks), but also multifactorial, as a rule, industry-specific problems. The formulation and resolution of such problems by various methods, in our opinion, belongs to the field of engineering creativity. Therefore, for the formation of universal competencies provided for by educational standards, it is necessary to ensure its large-scale application at the university.

At the same time, the severity of the issue under consideration is intensified due to the process of digital transformation of education that has begun [1, 2]. As part of this process, the information and methodological support of the educational process is digitalized, according to which the educational process must be provided with the necessary scientific and pedagogical, educational and methodological, information and reference, instructive and organizational, regulatory, methodological, technical and other materials presented in electronic (digital) form.

In connection with the foregoing, the study of methods of inventive activity in the context of increased innovation activity at domestic industrial enterprises to ensure accelerated technological sovereignty should be one of the areas of training of modern engineers.

A reliable and valuable result of educational and professional activities related to engineering creativity and the search for innovative solutions to industry problems is the development of new and original solutions and their protection by appropriate patents.

The importance of this complex pedagogical task has recently been growing due to the need to intensify innovative (inventive) activities at industrial enterprises in various industries to ensure the accelerated technological sovereignty of the country.

All over the world, inventive activity and patent protection of its results is one of the key tools for ensuring the competitiveness and economic growth of industrial organizations. For the state, the number of patents issued at a certain point in time is an indicator of the dynamics of the development of the industry and (indirectly) the level of its technological sovereignty. Thus, a patent for an invention or utility model is not only an individual indicator of the qualification level of a specialist (an element of his professional portfolio), but also, to a certain extent, a component of the global development potential of the industry in which this specialist is employed.

The process of drawing up an application for a patent requires the inventor to do a lot of methodological work, so not every original technical solution that has features of patentability is brought to a patent.

The procedure for generating an application requires the inventor to perform the following actions (some of them can be performed in parallel mode):

- drawing up a description of an invention or utility model (claim, sequence of implementation or application of the object of patenting);
- analysis of existing analogues and previously registered patents;
- formulation of requirements for an invention or utility model;
- definition of novelty, industrial applicability and inventive step.

In addition, when preparing an application, an engineer or researcher must take into account a number of specific requirements, the content of which is not entirely obvious even to specialists focused on technical creativity and its technologies. Thus, both the time for compiling an application and the likelihood of various errors appearing in it increase, which
the author will have to eliminate at the stages of examination of the application at the Federal Institute of Industrial Property (FIIP).

The research problem is determined by the gap between the level of methodological support for the educational activities of a university student in the field of engineering creativity (including inventive activity) and the needs of modern industrial enterprises focused on innovative development. In the context of the need to ensure accelerated technological sovereignty, this gap becomes even larger. Considering the dynamics of the processes of digital transformation of the domestic economy, it seems very useful to eliminate the identified problem not only with traditional technologies of higher education, but also with the development and implementation of a set of domestic software products focused on the university environment. The article presents a variant of one of these products that implement modern information and communication technologies.

As one of the digital tools to eliminate the shortcomings of university methodological support, it is proposed to use a service to automate the process of applying for a patent for an invention. The creation of such a service will allow:

- automate most of the work associated with writing and designing sections of the application;
- reduce the time for preparing the elements of the application;
- to reduce the costs of supporting the process of formation and filing of an application by patent experts;
- improve the quality of the content of the application, including by reducing the volume of formal errors;
- increase the motivation for patenting among novice inventors, as well as the productivity of inventors who already have patents.

All of the above circumstances determine the relevance of the topic of the article.

Thus, the purpose of the article is to justify the development and a fundamental description of the service to ensure inventive activity at the university, namely, to automate the process of generating a patent application. Such a service should be focused primarily on students and their needs. To achieve the goal of the article, it is necessary to solve the following tasks:

- perform an analysis of existing software tools for the formation and verification of patent applications;
- using university experience in preparing applications, formulate a step-by-step algorithm for the process of filing a patent application and evaluate the possibilities of its automation using the service;
- describe the functions performed by the service;
- to systematize the content essence of competence in the field of invention (knowledge, skills and practical experience) [3] of the members of the development team necessary to create a service;
- structure the benefits that are provided by the service in the process of its use.

2 Description of the proposed method

The methodological basis was the range of works published recently on the methodological support of industrial invention and patenting in the university environment, presented in Table 1.
Table 1. Methodological support of industrial invention and patenting in the university environment.

<table>
<thead>
<tr>
<th>№</th>
<th>Authors</th>
<th>Year of invention</th>
<th>Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Popov, Tashlykov [7]</td>
<td>2021</td>
<td>Nuclear energy</td>
</tr>
<tr>
<td>5</td>
<td>Glebov [10]</td>
<td>2017</td>
<td>Forest engineering</td>
</tr>
<tr>
<td>9</td>
<td>Neskoromnykh, Rozhkov [17]</td>
<td>2013</td>
<td>Exploration technologies</td>
</tr>
<tr>
<td>11</td>
<td>Bakatin [22]</td>
<td>2013</td>
<td>Transport engineering</td>
</tr>
<tr>
<td>12</td>
<td>Shipinsky [23]</td>
<td>2016</td>
<td>Packaging production</td>
</tr>
<tr>
<td>13</td>
<td>Efimov [24]</td>
<td>2011</td>
<td>Economics</td>
</tr>
</tbody>
</table>

The study also used the theory of the competence approach, reflected in numerous works of domestic scientists (Bolotov V. A., Bordovskaya N. V., Verbitsky A. A., Zeer E. F., Zimnyaya I. A., Pak N. I. and etc.). To solve the problems of the study, the following main research methods were used: theoretical analysis and generalization of the provisions of pedagogical science on the problems of professional training of students at universities; analysis of educational standards in technical areas of training.

3 Application of the method proposed

Before proceeding to the description of the elements of the service, it is necessary to consider the existing software that allows solving the problem of generating a patent application and its verification. Such an analysis will allow evaluating the capabilities of modern software products and clarifying the requirements for the elements of the service for generating applications. We list the common software products that are currently used to generate a patent application and its verification, and briefly describe their functionality.

PatentWizard (URL: https://neustelsoftware.com/patentwizard/) - Helps inventors generate patent applications, patent attorneys generate provisional applications, and provides automatic novelty screening.


Patent InSight Pro (URL: https://www.patentinsightpro.com/product.html) – uses artificial intelligence to analyze patent information, provides the user with information about competitive technologies and possible areas for patenting.
PatSnap (URL: https://www.patsnap.com/) is an online platform that provides access to databases of patents and technical solutions, helps users to search by keywords, analyze the market and competitive situation, and track patent applications.

ClaimMaster (URL: https://www.patentclaimmaster.com/) – Provides assistance in writing patent claims, automatically detects errors and offers suggestions for improving the wording.

However, the analysis of the presented programs showed that, despite the rather wide possibilities that they provide [25], they lack a Russian-language interface and do not take into account Russian requirements for the content and design of the elements of a patent application [26]. In addition, they do not take into account the requirements of regulatory documents for the protection of intellectual property rights adopted in Russia. Thus, these software products cannot be used by domestic researchers or engineers to prepare applications for the issuance of Russian patents.

This conclusion is true for the inventors (employees and students) of the Ural Federal University (UrFU). Being one of the most powerful centers for applied research in the country, UrFU cultivates an inventive environment for students of technical areas of study and broadcasts the accumulated positive experience in various industries. For example, over the past few years, in the most prestigious line of educational literature of the university (series "UrFU Textbook"), 2 textbooks on industrial inventions have been published, which have no modern analogues [16, 7]. Every year, about a hundred applications for a patent for an invention are sent from Ural Federal University to FIIP.

Thus, the development of a service to ensure the inventive activity of students will be a significant driver of the process of transforming new technical solutions developed in the university environment into the corresponding patents.

All the arguments presented justify the need to develop a university service to ensure inventive activity in Ural Federal University, which allows you to automatically generate an application for a patent. As noted, the main users of the service should be students of all levels of higher education.

It was previously noted that the use of the service will provide a reduction in the time for preparing an application and a more professional result. Along with this, it must be emphasized that working with the service does not replace the process of creative research necessary for the author to obtain a new technical solution, independently formulate a technical result, distinguishing features of the object of patenting, etc.

The service for inventive activity is a program that automates the process of generating an application for a patent for an invention or utility model or an application for state registration of a computer program. The two main functions that are carried out through the use of the service are:

– provision of forms and templates (including with the choice of special “industry phrases”) of the elements of the application for filling in by the author (authors);
– generation of interrelated text blocks (based on completed forms and templates), from which the text part of the application is completely formed (a patent for an invention, a utility model, a certificate of state registration of a computer program).

At the same time, it should be noted that in Russian universities the number of patent specialists who accompany inventive activity is, as a rule, small. Therefore, with an increase in student inventive activity, especially at the end of a calendar or academic year, university patent experts do not always have the opportunity to carefully work out the content of each application with the authors. Unnoticed errors and negligence increase the time for the application to be examined by FIIP and reduce the motivation of authors to patent their results of intellectual activity (RIA).
In this case, the service can help simplify and speed up the process of preparing applications, allowing university staff and students to independently develop and execute their RIA.

As practice shows, for a specialist, especially for a student who does not have experience in patenting, the process of drawing up a patent application can be very difficult. Attempts to analyze the process of transforming an idea into an application for training young inventors have been made since the middle of the last century. It should be noted that in the Soviet Union considerable attention was paid to the methodological training of novice inventors, so brochures with a brief but descriptive description of the stages of this process were published regularly, for example, we point to works (Shepelev, Kichkin, 1969) [27]; (Illenko et al., 1985) [28]. From relatively new manuals, one can single out the work of Tarasov I.S. [29] (Tarasov, 2013). Also in the last decade, manuals and guides on the design of sections of a patent application have been published separately, taking into account industry specifics, for example, in the field of construction (Ishkov, Stepanov, 2012) [30, 31].

At the same time, the well-known descriptions of the process of transforming an idea into an application were not intended for algorithmization, with the subsequent implementation of the algorithm in a digital environment. As a result of the analysis of various methodological support for industry-specific inventions and patenting in the university environment (see the Methodology and Methods section); diverse experience of a number of inventors from Ural Federal University, as well as their own experience in working on applications, a step-by-step algorithm for the process of filing a patent application was formulated.

In Table 2 presents a description of the enlarged steps of the non-automated algorithm for transforming an idea into a patent application, with appropriate comments in the form of questions to the author, for each step of the algorithm.

**Table 2. The content of the non-automated algorithm for compiling an application for a patent.**

<table>
<thead>
<tr>
<th>N algorithm step</th>
<th>Content of the algorithm step</th>
<th>Test questions for the author</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Define the idea of the invention</td>
<td>What object does the author want to patent (method, device, method and device for its implementation, etc.)? What are the essential features of the object?</td>
</tr>
<tr>
<td>2</td>
<td>Explore the idea, Is the idea underlying the technical solution new?</td>
<td>Does this idea (technical solution) appear in open sources of information, including in patent databases? Does a technical solution based on this idea violate someone's rights?</td>
</tr>
<tr>
<td>3</td>
<td>Turn to a patent specialist for help</td>
<td>What part of the idea (technical solution) should be described in the application? Is there enough information to form the elements of the application or is additional research needed?</td>
</tr>
<tr>
<td>4</td>
<td>Describing the idea as a formula of the object of patenting</td>
<td>Does the description of the formula include all the distinguishing features of the object being patented: design features, principle of operation, etc.? Does the formula use concise wording, is there redundant or conflicting information? Is there a uniformity of wording? Are the claims clear?</td>
</tr>
</tbody>
</table>
Continuation of Table 2.

<table>
<thead>
<tr>
<th>N algorithm step</th>
<th>Content of the algorithm step</th>
<th>Test questions for the author</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Formulate a description of the application of the object of patenting</td>
<td>Is the description of the field and the state of the art given?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Is there a description of the object that reveals its essence with completeness sufficient</td>
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<td></td>
<td></td>
<td>for the implementation of the invention (utility model) by a specialist in this field of</td>
</tr>
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<td></td>
<td></td>
<td>technology?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Does the formula match the description of the object?</td>
</tr>
<tr>
<td>6</td>
<td>Forming a graphical model of the object</td>
<td>Are the developed drawings (drawings, diagrams, diagrams, etc.) sufficient to clearly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>illustrate the distinguishing features of the patented object?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do they contain contradictions?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Are the drawings (drawings, diagrams) clear and illustrative?</td>
</tr>
<tr>
<td>7</td>
<td>We check the application</td>
<td>Does the application contain the necessary sections?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Does the text part of the application match the graphic part?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Is the graphic part enough?</td>
</tr>
<tr>
<td>8</td>
<td>Compiling an application package</td>
<td>Does the application have a complete text and graphic part?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Are attachments to the application required, if so, are they drawn up?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Has the patent application been completed? Has the patent holder and the source of funding</td>
</tr>
<tr>
<td></td>
<td></td>
<td>for the costs of examination of the application, registration and grant of a patent been</td>
</tr>
<tr>
<td></td>
<td></td>
<td>determined?</td>
</tr>
</tbody>
</table>

Each step of this algorithm can be, to a certain extent, automated due to the use of the service, which will, first of all, reduce the complexity and laboriousness of generating an application by avoiding the trial and error method, which, as indicated in manuals on industry inventions (see. above), novice authors inevitably gravitate. In addition, the probability of various errors occurring when writing an application will be significantly reduced due to automatic verification of the author's actions at the stages of algorithm implementation.

A service for automating inventive activity should perform a number of basic functions that best meet the requirements of the rules for describing an invention or utility model and drawing up a patent application. These features include:

1. Choosing the type of patent. The service should allow you to select the appropriate type of patent in accordance with the technical solution (product) for which the application is being filed. For the first version of the service, it is proposed to confine ourselves to the invention and utility model, with the subsequent expansion of this list (computer program, industrial design);
2. Filling out the patent application form. The service should provide the ability to fill out a patent application form, including such elements as title, field and level of technology, description, formula, abstract, graphic part (drawings) of the application, etc.;
3. Checking the application form for compliance with the requirements. The service must ensure that the application form is checked for compliance with the requirements of the formal examination of FIIP, for example: correct name, unity of names, volume of sections, etc.;
4. Create a list of documents. The service should generate a list of documents required for filing an application for a patent, for example, an application, an application, an application, an author's agreement and a questionnaire (for authors from Ural Federal University), etc.;
5. Tracking the status of a patent application. The service must provide information on the current status of the application to FIIP, the expected date of consideration and decision on the application by FIIP experts;
6. Support multi-user operation. The service should provide the ability to support the work of several users (authors) who can work on one application at the same time;
7. Integration with other systems. The service should provide the ability to integrate with other systems, such as e-mail, the database of patents, etc., to facilitate the process of filing a patent application and speed up its consideration by a patent specialist;
8. Availability of a line of templates of application elements (field and level of technology, description of the object, to disclose its essence, formula, abstract, etc.) developed by experienced inventors, as well as reference examples of the text and graphic parts of patent applications (by type), with taking into account industry specifics (construction, energy, mechanical engineering, radio electronics, etc.). The experience of the development of inventive activity in UrFU shows that such templates can be very useful, especially for novice inventors, for whom they are of independent educational value;
9. Assistance in drawing up a description of an invention or utility model. The service should provide detailed recommendations on preparing a description of an invention (utility model) so that the application is as clear and understandable as possible for the university patent specialist and FIIP experts;
10. Checking spelling and grammar: to avoid errors that may reduce the quality of the application; the service should provide spelling and grammar check of the text part of the application.

All these functions will help the author to form a high-quality patent application, which is likely to successfully pass both FIIP examinations and bring the author a well-deserved patent.

From the formulated functions of the service, it can be seen that its creation requires a team of specialists from different professional fields. The team should include: a task manager, a programmer, an experienced inventor, a patent specialist and several novice inventors (potential users of the future service) [32]. Further, the knowledge, skills and practical experience that the members of the service development team should have are systematized.

The task manager must:
- know general information about intellectual property and its protection, the basics of professional disciplines (by industry) to ensure that the technical aspects of the patented solution are taken into account in the service;
- be able to apply the knowledge of regulatory documents for the protection of intellectual property rights, draw up an algorithm that takes into account the industry-specific features of the patented solution;
- have practical experience setting tasks and developing algorithms in various subject areas.

The patent examiner must:
- know - the patent legislation of the Russian Federation; chapters of the Civil Code of the Russian Federation concerning copyright protection; separate orders of Rospatent and the Ministry of Economic Development of the Russian Federation;
- be able to assist the inventor in drawing up a description of the invention (utility model);
- have practical experience work in the patent department of the university.

An experienced inventor must:
- know - the principles of a systematic approach for building a model of a technical problem, requirements and recommendations for drawing up a patent application, algorithms for solving inventive problems related to the elimination of administrative contradictions, criteria for assessing the proximity of an inventive problem solution to an ideal variant, heuristic methods for developing new technical solutions, criteria evaluating the novelty of solving inventive problems, the algorithm for transforming the developed technical solution
into an application for a patent for an invention (utility model), industry regulatory framework;

be able to – apply standard methods for solving inventive problems related to the elimination of technical and physical contradictions, use heuristic techniques to develop new technical solutions, apply algorithms for solving inventive problems related to the elimination of various contradictions, use information templates for self-compile an application for a patent;

have practical experience – in applying methods to overcome psychological inertia in the process of analysis and synthesis of solving industry inventive problems, applying the methodology for searching for analogues and prototypes to solve an inventive problem, filing an application for a patent for an invention and utility model, successful developments in the field of invention to ensure holistic work components of the service for the formation of a high-quality application and understanding the needs of service users, especially novice inventors.

The programmer must:

know – modern programming languages and be fluent in them, databases and database management systems, machine learning and artificial intelligence methods for creating a service, basic methods and technologies in the field of information security to ensure the confidentiality of information of service users;

be able to – create web applications, use UX / UI design techniques to develop a convenient and intuitive interface, use cloud technologies to store and process data, provide access to the service through the corporate network and the Internet;

have practical experience – in the field of software development, analytical work to ensure the accuracy and efficiency of the service, the use of communication skills for the effective interaction of the development team with the customers of the service and its users, work with the Application Programming Interface (API) to integrate the service with other platforms, and services and improving its functions, developing user interfaces to create an interface that is comfortable to use in the educational process.

The presented complex of knowledge, skills and practical experience defines the essence of competence in the professional areas of the project participants and it should be considered as the minimum qualification requirements for the successful development of the service. Beginning motivated inventors will be useful in the team not only as users of the finished software product, but also as thoughtful “testers” of its intermediate versions at the stage of pilot operation of the software product.

We list the advantages of using the service to automate the process of generating a patent application and specify how these advantages are achieved:

− saving time: provided by the work of the inventor in special forms and templates, taking into account the type of patent, the type of technical solution (method, device, etc.), industry affiliation of the patented object;
− reduction of the probability of errors: provided by automatic checking of the text for compliance with the requirements of patent law and the rules for drafting applications;
− maintaining confidentiality: it is ensured by the integration of the service into the corporate network of the university, which has a high degree of protection;
− ease of use: provided by the presence of a convenient and intuitive interface that helps to technologically form and edit the structural elements of the application;
− saving money: provided by reducing the labor costs of a patent specialist for a stage-by-stage analysis of the application of a novice inventor: formula; disclosure of the use of the patented object; drawings (diagrams); full application form;
− reducing the risk of refusal to grant a patent: it is ensured by improving the quality of the preparation of an application through the implementation of formal checks in the service (requirements for the formal examination of FIIP);
the possibility of receiving feedback from a patent specialist (an experienced inventor): it is provided by providing the user with feedback on filling out the application, in which the inventor indicates errors and inaccuracies that need to be corrected before sending the application to FIPS;

improving the inventive experience of the user: provided by the formation of practical experience in the field of drafting patent applications, as well as gaining knowledge in the field of patent law.

All the advantages presented make the service for automating the process of generating patent applications a useful and relevant tool for students, researchers and other university staff interested in protecting their intellectual property.

4 Conclusion

The main advantages of creating and using a service to support inventive activities at the university are: accelerating the process of creating patent applications by students, reducing the cost of preparing applications and improving their quality. In addition, the service can be integrated with other systems, such as patent databases (Yandex Patents and FIIP), which will allow you to quickly analyze prototypes, analogues and evaluate the novelty of the patented solution. The development of the service is associated with the expansion of its functionality. For example, the service may also contain educational materials on the most effective methods of invention, taking into account the specifics of the student's field of study [33].

At the same time, it should be emphasized that the use of the application generation service does not replace the need to interact with university patent experts or experienced inventors at the stage of making a decision to send an application to FIIP.

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