Digital platform of scientific and technological competencies

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Abstract. Nowadays changes in the hitech market occur quickly. The higher ability of scientific organization to change, the higher its chances to become a technological and scientific leader. One of the key factors for the successful implementation of scientific developments are scientific and technical competencies that allow correct assessment of the situation, predict own and partners' technological risks. [1].

As a rule, scientific and technological competencies are based on scientometric indicators (scientific indices, publications, patents, etc.). There are many examples of scientific results successfully described on paper, but not implemented in projects for one reason or another. Therefore it is proposed in this report to modify the competence indicators set by adding of TRL indices of completed and current projects. A unified digital platform is supposed to include information base on scientometric indicators, existing technologies and ones under development, implemented and current R&D/scientific projects, experimental equipment database, computer codes, scientific and technical services of organizations within Rosatom State Corporation, as well as independent confirmation of this information from open sources. The platform will become a unified information array for a full description of scientific and technical competencies of R&D companies. The platform should cover not only the scientific organizations of the outline of the State Corporation, but also associated universities with the ability to describe the competences of scientific organizations form adjacent industries. The digital platform of scientific and technical competencies is a tool to effectively inform customers and potential partners to support decision-making process. The platform will allow to present data on scientific and technical activities in a single information space, use it to search for potential partners, and to exhibit Rosatom’s own capabilities to external users. The platform will allow users to establish R&D network which helps to launch new innovative projects.

1. Introduction

Today, market change is fast. The higher the response time of a scientific institution to changes, the higher its chances of becoming a technological and scientific leader.

One of the key factors for the successful implementation of scientific developments are scientific and technological competencies that allow correct assessment of the situation, predict own and partners' technological risks. [1].

As a rule, scientific and technological competencies are based on scientometric indicators (scientific indices, publications, patents, etc.). There are many examples of scientific results successfully described on paper, but not implemented in projects for one reason or another. One of the
reasons therefor is the lack of realistic view of the current status of research and development, including the possibility of its digital evaluation. In this regard, it is advisable to include the Technology Project Readiness Levels (TPRL) in the composition of competency indicators.

With this in mind, and given the current state-of-art information technologies, the prerequisites are in place for creating a unified smart digital platform which should in itself integrate the information base of scientometric indicators, existing and emerging technologies, implemented and being implemented R&D/scientific projects, experimental base, reference codes, scientific and technical services of entities of Rosatom State Corporation and reference support of this information from open sources. This will become a single information array for comprehensive description of scientific and technological competencies. The platform should cover not only the scientific institution of the State Corporation network, but also specialized universities with the possibility of describing the competencies of out-of-the-industry scientific institutions.

The digital platform of scientific and technological competencies is a tool for efficient search and notification of customers and partners for decision making. The platform will allow presenting data on scientific and technological activities in a single information space. The platform will allow users to establish contacts for creation and implementation of scientific and innovative projects.

One of the key functions of the platform is digitization of R&D results based on the TPRL readiness levels method. It is expected that the platform will assist in obtaining an initial assessment of outcome of scientific and technological problems to be resolved, and will be used as a tool for efficient management of the entity.

2. Purpose and objectives of the platform
The purpose of developing the first version of “Scientific, technological and technical competencies of organizations of Rosatom State Corporation” platform is to create a convenient tool for searching potential customers and partners in the field of scientific and technological activities, to create a “showcase” of competencies, to identify leading organizations in areas and centers of excellence.

The platform to be created is also a tool for efficient management of a scientific institution, an aid in making management decisions.

The key objectives of the platform include:

- Developing a platform-tool for entering, searching, working with data on scientific and technological competencies of scientific institutions in the network of Rosatom State Corporation.
- Creating a single window of data on scientific and technological competencies of institutions and supporting universities, including information on the scientometric indicators of institutions, existing and expected technologies, experimental base, R&D being implemented.
- Developing a tool for demonstrating the competencies of scientific institutions of Rosatom.
- Digitalization of R&D results.
- Identifying "strong" and "weak" competencies and references of scientific disciplines.
- Identifying leading organizations in scientific areas, arranging of research centers by areas.
- Searching for customers and partners for the implementation/order of sci-tech services;
- Evaluating the performance and cost of research projects.
- Making informed decisions on the development of fundamental and applied research areas for the development of future technology.

3. Key Concepts
Platform is an online platform for searching and exchanging information on the scientific and technical activities of institutions in the network of Rosatom State Corporation, as well as of the supporting universities and the scientific and technological partners of Rosatom. The platform is an open resource that any external users may access. However, there are sections on the platform with restricted access for users, access to information of which is only available to authorized employees of Rosatom State Corporation.
Scientific and technological competency (or STC) is a set of interrelated concepts, skills (expertise), abilities, and technologies (including scientific equipment) that provide institutions with an efficient solution to technological problems. Scientific and technological competency is a unit of analysis of scientific and technological capacity of institutions. STC is described on the basis of the classifiers of State Classifier of Scientific and Technical Information and the area of scientific and technological activities (hereinafter referred to as STA).

Scientometric data refer to quantitative characteristics used to measure the effectiveness and efficiency of scientific activities. The data include numerical performance indicators of competency and its supporting staff.

Experimental base includes laboratory equipment, bench equipment, pilot plants, etc. The data contain key characteristics, locations of the experimental base and employees responsible for the operation of instruments and equipment.

Reference solutions - a list of samples/examples of R&D projects completed over the past three years or being under way that give a clear idea of scientific and technological competencies of institutions to date, technology readiness and relevance (TRL/MRL/CRL), the dynamics of R&D/project development targeted at open innovation market.

4. Section "Scientific and Technological Capacity of Rosatom Institutions"

The scientific and technological capacity of the institution is determined on the basis of the description and evaluation of scientific and technological competencies.

Description, analysis and evaluation of the capacity is carried out for the development of technology, the creation of competitive products, making sound management decisions in the field of science and technology.

Key objectives of building a scientific and technological capacity:

- concentration of competencies for the development of "points of growth" (centers of excellence) in scientific and technological areas without duplication;
- preparation of scientific and technological programs;
- determination of funding parameters (basic target and long-term funding) of research programs/project with identification of customers;
- increasing the efficiency of using the experimental base;
- creation of a full-fledged internal competitive environment based on the incentives for the achieved scientific results;
- sustainable development of the scientific intellectual potential of Rosatom institutions and supporting universities;
- PR of scientific developments, raising awareness of the scientific and technological activities and the attractiveness of scientific institutions in the Rosatom network.

Each scientific and technological competency is positioned at the intersection of the area of scientific and technological activities and the classifier under the headings of scientific and technological information (hereinafter - GRNTI).

Areas of Rosatom STA (currently 74 areas are identified within the framework of prioritization of STA and presented at the Strategic Council in July 2015) are areas that ensure maintenance and development of key business processes in the industry. STA are updated once every three years as part of the process audit of Rosatom State Corporation and/or as new areas emerge together with the scientific community, business divisions and external consultants.

The GRNTI classifier allows selecting a suitable scientific area for the correct positioning of competencies. The use of GRNTI classification of scientific areas provides the following advantages:

- status of the official system in Russia for the purposes of R&D accounting;
- it is kept up-to-date by the Interdepartmental Classification Commission.
- the most broad based and detailed system;
- three-level classification system allows aggregating information with varying levels of detail;
widely used (in the RSCI system and other accounting resources).

Scientific and technological competencies include a number of the following elements, which may be refined and expanded, as applicable.

5. Section "Scientific and Technological Competencies of Supporting Universities of Rosatom"
The scientific and technological competency of supporting universities is determined similarly to that for the institutions of Rosatom State Corporation.

Analysis on the basis of scientific and technological competencies of the supporting universities provides:

- unprejudiced understanding of the advantages and opportunities of the university research complex;
- understanding the maturity of competencies, redundancy and deficient areas to perform R&D;
- identification of areas for the development of new competencies (including taking into account the digitalization trend);
- identification of scientific leaders.

The format for the description of the scientific and technological competencies of the supporting universities is similar to the format of the competencies of the Rosatom institutions.

6. Examination Section
The platform also provides an examination section. Its key objectives include:

- determination of the list of experts;
- examination of the existing competencies of institutions of Rosatom State Corporation and supporting universities;
- assistance to the examination of the proposed projects;
- examination of areas, identification of strengths and weaknesses, problem areas;
- other types of examination.

7. Section "Showcase" of Competencies
“Showcase” of competencies performs the function of collecting relevant information about existing competencies and products of institutions and universities of Rosatom State Corporation, as well as information about the demanded knowledge/products/competencies. The key function of the “showcase” of competencies is to fill in “empty” zones, search and selection of experts or teams capable of performing the required R&D. The “showcase” also provides the external organizations with the opportunity to obtain publicly available information about existing competencies or existing requests or needs of institutions of the Rosatom network.

The “showcase” of competencies will include several subsections having different functions and intended for different levels of users. At the top level, four key elements are expected, namely: “Products”, “Technology”, “Services”, “Experimental Base”.

Each subsection will have a function to search for the necessary information/competencies/technology or products that meet the needs of institutions or external users.

The final element of the section will be a technology or competency card containing basic information about a prospective R&D developer and a brief description. The final element may be a card containing a request for the development of a specific technology or product.

8. Other Work within the Platform Included in Other Sections

8.1. Reference R&D/ Projects: Confirmation of Scientific and Technological Competency
Information on R&D implemented over the last three years and performed by a group of competency carriers is currently generated as a result of an R&D inventory and is a collection and sequence of information about research and development.
R&D and works/services performed in pursuance of R&D (hereinafter referred to as works) are subject to inventory.

8.2. Experimental Base
The platform contains an account of the experimental base for each competency, which will also be an element of the verification of the availability and level of development of competencies. The list of experimental base will allow scheduling work on the development of new technology by identifying resources available to enterprises and supporting universities of Rosatom State Corporation.

8.3. Codes
Information on codes is an element of scientific and technological competencies and their digitalization. Currently, there is no complete database of the available codes, there is also no strict classification of “Codes”, however there are suggestions to apply the following principles.

Codes are divided into two key areas:
- "Design codes”.
- "New generation codes"

The main feature of the new generation code is that when solving problems of supporting the design and safety case on an industrial scale, it provides higher accuracy and reliability of the calculated results compared to the design codes used today.

8.4. “Competency Navigator” (“internal navigator”)
The platform will implement the function “competency navigator” - a system for searching and verifying the data provided.

One of the navigator features is the automatic verification of the correctness of completing the formats of competency cards. For each scientific and technological competency (the name of the competency, the head/leader of R&D team) there is the function of indexing (determining the numerical index), taking into account the number of articles/reports at conferences /participation in Russian and international projects /patents using the search query generator-editor applying the keywords from competencies, thesaurus, as well as semantically similar words (“semantic search”). The search is conducted by fixed open information sources, such as application management system of Rosatom, Scopus, SQL, the R&D Federal Target Program of the Ministry of Education and Science, the Russian Science Citation Index, the Russian Science Foundation, the Russian patent database, etc.

Objectives of the “competency navigator”:
- automation of the process of compiling and verifying the competencies of an institution;
- competency analysis according to a given metrics;
- identification of centers of excellence (organizations, laboratories) based on the results of their evaluation;
- preparation of information for the establishment of project teams at the national and global levels;
- identification of STC for the strategic development areas of the institution.

Objectives implemented by the competency navigator:
- unified approach and automation of the process of compilation and verification of competencies.
- identifying lack of information and logical contradictions;
- generating target search function;
- input of keywords and target function;
- context-dependent dictionary generation;
- search query generation;
- query filtering using corporate thesaurus;
- fixed database search;
• expert refinement of the search query results (if applicable);
• processing of query statistics (by scientometric indicators);
• visualization of search results on the competency card with output of target function value;
• output on request of the values of components for the selected competency (scientometric indicators for individual items: published articles, conferences, projects, grants, patents);
• generating dimensions of data on various parameters of competencies for the purpose of their analysis and harmonization;
• ability to use filter to search for the required data;
• compiling databases by identifiers of sources found during the search (keywords, DOI, ORC ID...) for subsequent linkage to Scopus systems and equivalents;
• integration of the regulatory documents reference database and library of successful practices and cases (optional).

When using the navigator, the ability of obtaining data in popular formats (MSWord, MSExcel, PDF, etc.) shall be provided.

8.5. Technology Readiness Levels
The digital platform will have a tool for determining the levels of readiness of R&D and technology using the TPRL methodology [2]. Evaluation and assignment to the technology readiness level is performed for the purpose of:
• numerical evaluation of R&D results;
• determining the level of development of the scientific and technological competencies relevant to the subject of R&D;
• comparisons with technological indicators of competing companies;
• assessing the scientific and technological capacity of the institutions of Rosatom State Corporation for the development of end-to-end technology in the field of digital economy (in terms of civilian research, development, testing and engineering).

Technology readiness levels are unified criteria (harmonized with generally recognized criteria) for assessing the readiness of R&D results (technology, materials, components, production processes, systems, subsystems, etc.) to their application in production, plants, processes to achieve the intended use of the latter, as well as technological risks associated with the use of this technology at the moment.

9. Other Platform Features
The platform provides for the implementation of a tool for verifying the scientific and technical competency of institutions which will reflect the steps to verify each competence.

The mechanism consists of three levels of verification after which the competency becomes publicly available. The first stage of verification is to enter the full list of information on competency and institution. The second stage of verification is an expert verification of the existence of this competency, its relevance and applicability. The third stage of verification is scientometric analysis, consideration of reports and publications prepared by the institution under this competency.

As part of the work on the platform, a graphic design of the interface for all elements of the system is being developed (both in the format of use with personal computers and mobile devices).

This module is the core of the information system. It is developed on the client server computing principle, with data storage in relational data base management system.

The platform shall contain graphical interfaces for viewing the catalog on the web, as well as for the administration of users and data.

Platform requirements:
• access to the platform shall be via the Internet;
• the platform shall meet security requirements;
• user credentials (login and password) shall be stored in an encrypted database;
• user session shall be reliably protected against interception or impersonation;
• the platform shall be adaptive to work with tablets and mobile screens of 5 inches and above;
• publicly available state-of-art technology of html 5 and css 3 shall be used.
• The set of interfaces includes the following elements:
  • user interface;
  • interface of institutions;
  • interface of cards of scientific and technological competencies for Rosatom institutions;
  • user role interface;
  • interface of scientometric indicators, including analytical data export;
  • interface of cards of scientific and technological competencies for universities;
  • experimental base interface;
  • area code interface;
  • competency navigator interface;
  • technology readiness level interface;
  • “competency showcase” interface.

10. Software solutions
Bringing most of the information systems of the Proryv IIE into the category of optional for the entire life cycle is possible only with the arrangement of support for the work with the data obtained from these systems by the integrated tools of PLM. Standard PTC Windchill functionality does not provide such support, so it was necessary to make changes to the data structures and develop additional modules to support such functions as:
• management of R&D results in the context of roadmaps;
• monitoring of construction works;
• quality management;
• requirements management;
• providing data on the stages of the facility operation and decommissioning;
• depositing and storage of design codes;
• storage of experimental data;
• information support for expert examination.

When developing software, programming languages were used that were not dependent of the implementation platform (JAVA, XML, JAVASCRIPT), which holds out a hope of their support during the entire life cycle of the project.

11. Conclusion
Today, the State Atomic Energy Corporation Rosatom is actively working in the field of analyzing scientific and technological competencies, collecting and structuring them, by searching for new ways to use the data and expanding the database through greater detail and incorporating the most important aspects for better analysis.
The digital platform will allow creating a unified public tool aimed at development of the scientific sector and obtaining results for further implementation in production. The digital platform is announced as one of the IT initiatives as part of industry digitalization.

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