
Algorithm of Identification and Search for New Market Applications of Unique Technological Competences

A.I. Kashirin^{1,2}

Abstract:

The main goal of corporate knowledge base of the key competence is to transform the knowledge and experience of employees into the intellectual capital of the enterprise.

The knowledge base of the competence is an effectively managed centralized electronic archive of documents, reference books, classifiers and other formalized information materials of the company.

An important part of the work on building a corporate knowledge base is the identification, verbalization of unformalized knowledge of employees, the central place among which is occupied by unique technological competences.

The paper proposes the algorithm of the search for new markets for unique technological competences what should also be put into the knowledge database.

Keywords: *Competitiveness, corporate knowledge base, core competencies, competitive strategy, unique technological competencies, market application.*

JEL Classification: *M10, M15.*

¹ State Corporation "Rostec"

² Peoples' Friendship University of Russia, e-mail: kashirin_ai@pfur.ru

1. Introduction

The algorithm is aimed at assisting the teams of Unique Technological Competencies (UTCs), managers, designers, engineers, and production engineers in the organization of the work related to identification, description and commercialization of unique technological competencies, including the planning and implementation of this activity.

The unique technological competence of a team, is the combination of knowledge, skills, abilities of scientists, specialists that allows them to create innovative technologies and products for various applications, the technical characteristics of which meet the criteria of global superiority, exceed the characteristics of the best world analogues, or global competitiveness, comparable to the characteristics of the best world analogues (Lobanova, 2002).

UTC is a distinctive skill (ability) of a team of specialists of a company to perform in the best way specific actions in a certain technical (engineering) field, which allows them to develop new competitive technologies and products and to lead the market. As a rule, UTC arises on the basis of existing technological competencies in the process of solving new (non-standard) tasks and involves the use of an intelligent non-standard approach (Mincberg et al., 2001). The ultimate goal of working with UTCs is their commercialization. The choice of the unique technological competencies available at the enterprise is determined by the fact that the uniqueness contained in them enables the creation of innovative products and services that also have uniqueness, and, consequently, global superiority or global competitiveness (Min'ko et al., 2014). Commercialization of UTCs is one of the important ways to ensure the market leadership of the company.

The proposed algorithm is based on the analysis of theoretical approaches and tested in practice. The technique distinguishes two types of one UTC - product and process envisages a multilevel structure and separate descriptions corresponding to each level.

2. Identification and description of product UTCs

The process of identifying the unique technological competencies is presented in the form of a step-by-step algorithm that requires answers to the questions formulated below and entering these answers into the UTC formulation identification and formation format, necessary for ordering and organization of information about the UTCs. The first question of the algorithm is: *“What product manufactured in the company possesses global superiority in comparison with competitors or global competitiveness? What is the function (purpose) of this product and for what object does this function work?”*

Formulate the name of the product that is sold in the market and has a global superiority or global competitiveness. In these recommendations, such a product is defined as advanced. If the organization has several advanced products, identifying the UTC and, therefore, filling in the format, is needed to be accomplished for each of them (Nesterov, 2005). One should specify the function (purpose) of the advanced product and note in respect of which object this function is valid. "Function" and "object" will be used later in search of options for the commercialization of UTCs.

The second question of the algorithm is: *“What are the distinctive technical characteristics, competitive advantages of the advanced product in comparison to the nearest world analogues, which are needed to be confirmed by specific quantitative indicators?”*

To answer this question, it is recommended to analyze (compare) the advanced product in terms of technical characteristics with several closest analogues in the form of a competitive table, and the results of this analysis to be transferred to the format.

The third question of the algorithm is: *“What specific key element (component) of the advanced product manufactured in the organization has unique technical characteristics, which, in fact, make this product advanced, and what are specific indicators of these characteristics?”*

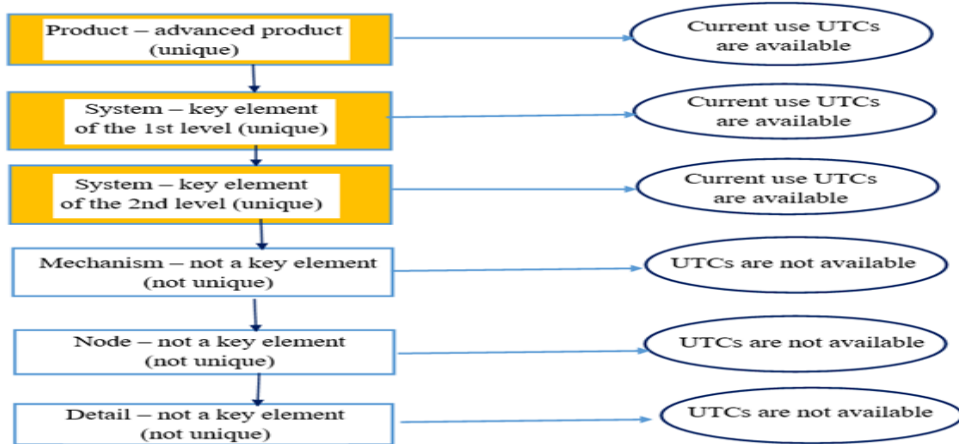
The uniqueness of the advanced product is not ensured by all its component parts, but only one or several elements that have uniqueness and are made directly by the employees of the organization. In these recommendations, such an element is defined as key. To identify the key element, it is necessary to decompose the advanced product into its component parts, identifying the key element that makes the product unique (Nestik, 2014).

Like an advanced product, a key element is not generally unique due to all its component parts, but only due to one or more parts, so the decomposition should be continued and with respect to the key element. The decomposition should be carried out to the level after which it becomes impossible or uniqueness is lost. The abilities to develop and produce an advanced product and its key elements represent the unique technological competencies of the current application, which are defined in these recommendations as product UTCs. The sign of the product UTC is the availability of words: to design, develop, create, and produce a product.

In practice, it often happens that the key element, ensuring the unique technical characteristics of the advanced product produced in this enterprise, comes from a third-party supplier as a component. Such a key element and its technical characteristics are excluded from consideration since the ability to create this key element is the unique technological competence of the enterprise of the third-party

supplier (Prahalad, Hamel, 2014). Schematically, the process of decomposition of the advanced product and key elements is shown in Figure 1.

Figure 1. General scheme of decomposition of the advanced product into key elements.



3. Identification and description of process UTCs

Unique technological competencies are found not only in products but also in processes. To identify and describe them, it is needed to use the following step-by-step algorithm, answering questions and entering information into the format.

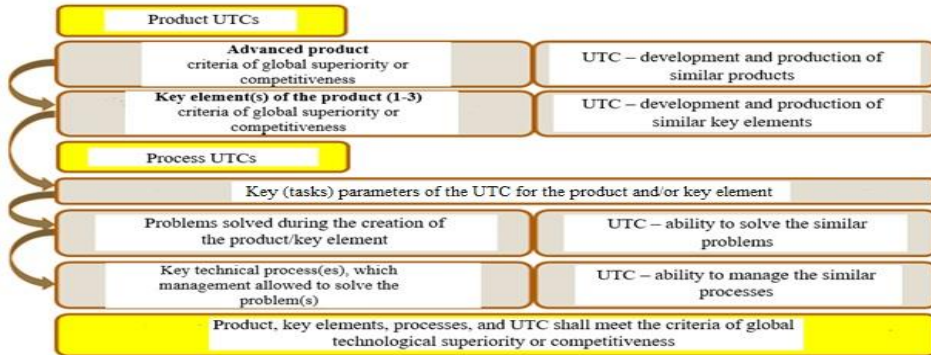
The question of the algorithm is: “*What is (are) the main task(s) raised within the framework of the technical assignment for the development and creation of an advanced product?*” It is necessary to summarize this task by specifying the given technical parameters.

The question of the algorithm is: “*What scientific and technical problem (problems) was (were) solved in the course of this task?*” The accomplishment of the assigned task is usually associated with the solution of complicated scientific and technical problems. Not any problem is of interest, but only the one whose solution allowed the advanced product to obtain technical results and characteristics unattainable for competitors. The abilities to solve such tasks and problems, that is, to manage certain processes and phenomena, in these recommendations are defined as the process UTCs. The sign of the process UTC is the availability of words: to manage, to form, to model, to modify, to regulate.

In contrast to the description of technology, which requires the disclosure of complete information (sequence of actions, conditions, devices used, substances, etc.), which may constitute a commercial or other secret, the description of UTCs is limited only to indicating what the competence holders are able to do, what kind of

problems they can solve. This greatly eliminates or significantly reduces the risk of confidential information being distributed. Skills to solve the above problems are the process UTCs of current use. Schematically, the algorithm for identifying product and process UTCs is presented in Figure 2.

Figure 2. UTCs Determination Algorithm



4. Search for directions and options for the commercialization of UTC

As the business practice shows, the commercialization can be realized both in the form of a product and in the form of a service. UTCs can be commercialized in both directions. On their basis, new innovative products that are superior to the world level or globally competitive can be developed and marketed. This direction is defined in these recommendations as "new products" (Pungin and Lungina, 2010). UTCs can also be offered to the market in the form of services to solve current scientific and technical problems and prospective tasks of external customers, first of all, those that are impossible or impractical to solve in an ordinary way, or when a new method creates significant competitive advantages. This is the direction of the UTC commercialization, focused on external customers, and is defined as "custom services" (Simonova and Zazovskaya, 2000). Both directions of commercialization can be successfully applied to both product and process UTCs, which is schematically shown in Figure 3. The search for options for commercialization of product and process UTCs and filling in the UTCs commercialization direction formation format is carried out for each individual UTC (Snurnitsyn, 2008). This activity is presented as a step-by-step algorithm that requires answers to the following questions and the inclusion of these answers in the format.

The first question of the algorithm is: "Can the product UTC, which was identified and included in the format, be applied to this object only, or it may be applied to a broader (more generalized) class of objects?" In this case, the "generalization principle" is applied to the "object" in respect to which the action of the advanced product is carried out, which allows a wider consideration of the scope of possible commercialization of competence while maintaining its uniqueness. The

generalization can have several levels, depending on the essence of the UTC, as it will be shown in Figure 4.

Figure 3. Possible directions of UTCs commercialization

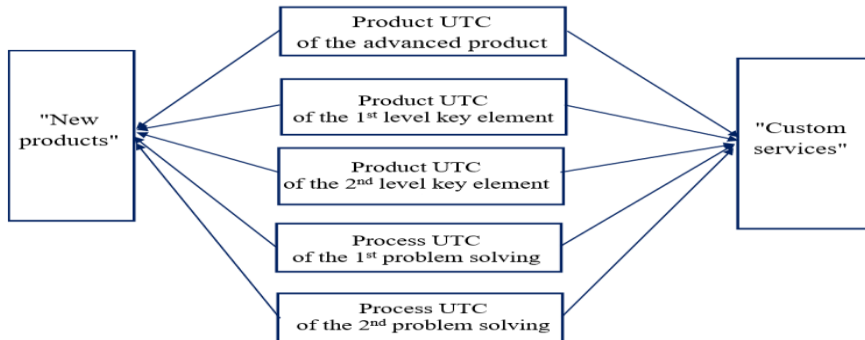
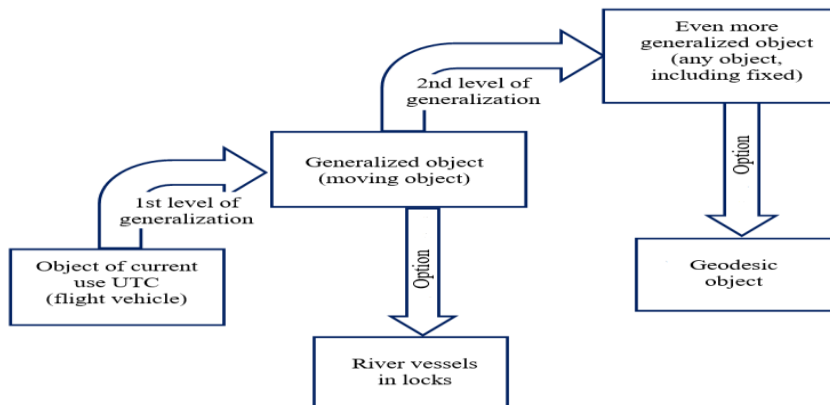


Figure 4. Generalization of the UTC



The second question of the algorithm is: “*In what new specific applications can this UTC be used, taking into account the generalization conducted?*” When searching for new specific options for commercialization of UTC, the principle “from general to private” is used, which allows identifying the possibility of using this UTC in new areas. This requires creativity, lateral thinking and a number of other techniques and mechanisms that will be discussed below. Schematically, this process, based on a specific example, is presented in Figure 4.

This algorithm can also be successfully applied not only to the UTCs of the level of the advanced product but also to the UTCs of the key elements level of this product.

Proof of this is the example of Honda Company which in the fifties of the last century produced mopeds that became very popular not only in Japan but also abroad. Over time, the company began to experience serious competition in the world market and that forced it to look for new ways of commercialization of its products. It turned out that the key element that provided the advanced product (mopeds) global competitiveness was a high-quality gasoline engine. Having identified this key element, which corresponded to the product UTC for its development and production, the company went on the path of self-commercialization of gasoline engines in other applications. Using in practice the "principle of generalization", Honda passed from mopeds to the general class, the class of moving objects and used its motors in boats, small-scale mechanization machines, lawnmowers, and then, having reached a new level of generalization, began to use engines in various types of fixed objects: generators, water pumps, mini power plants, and other industrial equipment.

The algorithm used to search options of commercialization of the process UTC is as follows. Identified process UTC is split into meaningful sections. The formulated process UTC for subsequent search for new applications of the model is split into notional sections: a) what task (problem) is the UTC team able to solve, b) in respect of what object, c) how technically and what is the objective function of the application. This breakdown allows subsequent iteration with separate semantic parts of the UTC in order to reach new applications (commercialization options). As a result, we receive proposals for new applications of the process UTC. Here is an example of the effectiveness of the "generalization principle" and "principle from general to particular" in the search for new directions and options for the use of the process UTC.

The employees of Elsis, a small innovative company, *"are able to register and measure amplitude and frequency characteristics of micro-vibrations of different points of the skin of the human face, which allows interpreting its psycho-emotional state on the basis of video signal"*. This UTC is implemented as a product "Non-contact detector to identify potentially dangerous people in the stream", which has found practical application during the Winter Olympic Games in Sochi, in 2014. This technology detects and registers a person's hidden illegal intentions which are reflected in his or her inner excitement but are not visible to the naked eye. The use of this product has allowed identifying more than 1000 people as dangerous from the point of safety in the flow of visitors of the Olympics as well as preventing attempts to smuggle prohibited items and penetrate the facilities using fake documents. The "principle of generalization" helped to determine the possibility of applying the process UTC for the human body in general (the first level of generalization), and in the search for specific options of commercialization ("principle from general to particular") the possibility of its use for remote rapid analysis to define breast cancer of women was established (with a probability of up to 95 %).

The transition to the second level of generalization led the company's employees from human to non-living objects. The search for options for the commercialization of this UTC, taking into account the generalization, revealed the ability to measure the amplitude and frequency characteristics of micro-vibrations in plants. As a result, with the help of this process UTC, it is possible to determine with 95% probability whether the seeds are genetically modified.

In order to identify new possible options for the commercialization of UTC, it is necessary to actively use creative thinking, different methods and approaches to form the image of a new product and its scope of application, in particular: "Brainstorming" (allows during the generation of ideas and their subsequent grouping, selection and evaluation to develop the most effective and often unexpected proposals), "Lateral marketing" (helps generate new ideas that neither consumers nor market research can offer), "Pivot" method (used in small innovative companies to develop hypotheses about new products), classifiers (to search for possible options for new products, based on the most general formulation of the product function, intended to be created on the basis of it, using synonyms and the broadest ontology), queries to universal and specialized search engines (to search for possible application ideas, using the full power of semantics of Google portals and others), various possible combinations of UTCs available in the enterprise, search for problems and tasks of potential customers. The resulting commercialization options need to be thoroughly analyzed, and there is a need to select those that appear to be the most effective and practical.

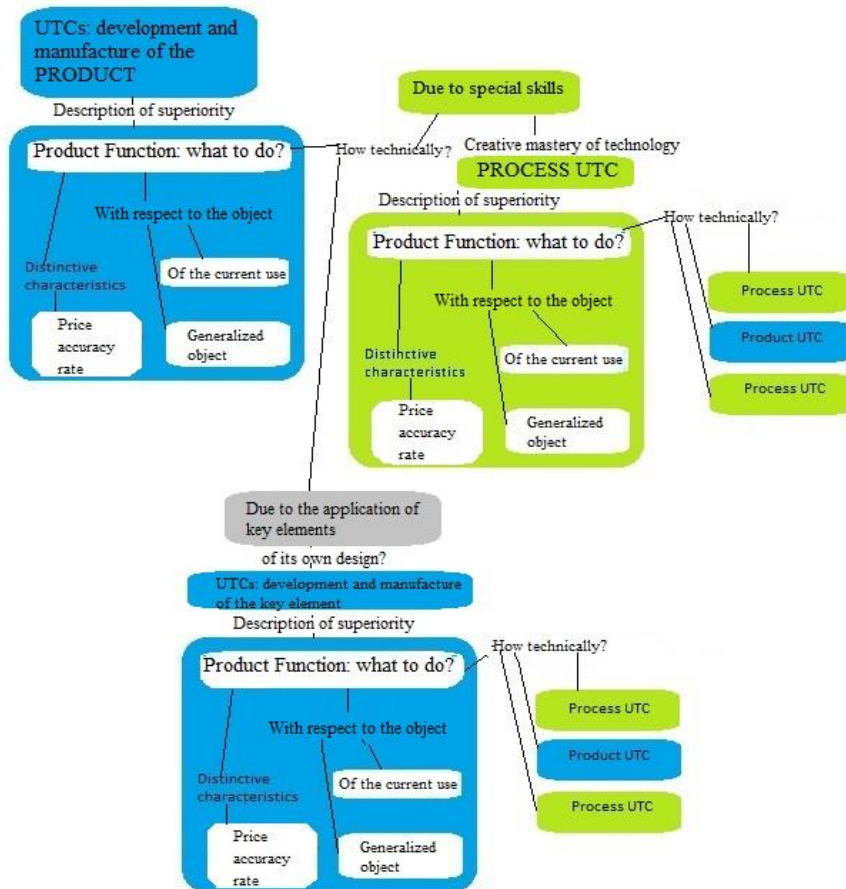
Below are the UTCs identification and description format and UTCs commercialization directions formation format, which were developed by a team of scientists, including the author, and are used to systematize information about the UTCs.

UTCs identification and description format is as follows: describe your leading innovative product, the technological problems that were managed to be solved during its development and give the formulation for the resulted unique technological competences of the teams. Let us present the format of a competitive table to compare the technical and economic characteristics of products and their key elements of the organization and the best companies in the world. Practice shows that often competitors for the product and the key element are different. Similar tables should be compiled for the product, key elements, and process UTCs. The above UTCs identification and description format is associated with the UTCs commercialization directions formation format by serial numbers, which indicates the systematic nature of the work being carried out.

UTCs commercialization directions formation is as follows: describe (each) technological problem that (often for the first time) was solved during the development of the company's advanced product. Give the formulation of the resulting unique technological competence of the team. The diagram below (Figure

5) shows the cause-and-effect relations in the form of information trees (graphs), whose nodes are the competences of lower levels, providing the competences of higher levels.

Figure 5. Relations of the different level competences



5. Conclusions

1. The work of identifying unique technological competencies begins with the identification of advanced products produced at the enterprise, as well as the key elements that have a global advantage over competitors (exceed them) or global competitiveness (are at the level of competitors).
2. The key elements are identified by decomposition of the advanced product to the level where their uniqueness is preserved.
3. The abilities to develop and produce advanced products and their key elements are product UTCs, and the abilities to solve scientific and technical

- problems encountered in the development and production of advanced products and its key elements, are process UTCs.
4. Commercialization of the UTC can be carried out in two directions: in the form of products that are superior to the world level or globally competitive (the “new products” direction) and in the form of services for external customers in order to solve their current scientific and technical problems and future challenges (the “custom services” direction). Both directions of commercialization can be applicable for both product and process UTCs.
 5. To find possible options for the commercialization of the UTC, it seems appropriate to use the “generalization principle”, which allows determining the direction of the commercialization of the UTC without losing the revealed uniqueness. The next step in the process of search for commercialization options is the “general-to-private principle”, which identifies specific areas of the UTCs application.
 6. When searching for new areas of the UTCs application one should actively use the creative thinking of the carriers of competence, “brainstorming”, classifiers, search queries, search engines, search for problems and tasks, and other ways to promote the formation of the image of a new product or service and identify possible areas of their application.

Acknowledgement:

This paper was financially supported by the Ministry of Education and Science of the Russian Federation on the project No. 26.1146.2017/4.6 «Development of mathematical methods to forecast efficiency of using space services in the national economy».

References:

- Lobanova, T.N. 2002. Building a Model of Key Competencies. Handbook on Personnel Management 8, 23-31.
- Minberg, G.B., Alstrjend, J.L. 2001. School of Strategies. St. Petersburg.
- Min'ko, E.V., Zav'yalov, O.A. and Min'ko, A.E. 2014. Evaluation of Commercial Project Effectiveness. St. Petersburg.
- Nesterov, A.V. 2005. Competence. Essence of Concept, its Modern Application. Competence 1(18), 121-134.
- Nestik, T.A. 2014. Collective Image of the Future: Social and Psychological Aspects of Forecasting. Questions of Psychology 1.
- Prahalad, K.K. and Hamel, G. 2014. Core Competences of the Corporation in H. Mintzberg, J. Quinn and S. Ghoshal (eds.), “Strategic process”, St. Petersburg.
- Pungin, I.V. and Lungina, V.S. 2010. Systematization of Indicators of an Estimation of Competitiveness and Efficiency Based on Target Approach. Synergia, Moscow.
- Simonova, I.F. and Zazovskaya, N.M. 2000. Strategic Aspects of Personnel Management: Textbook. Gubkin Russian State University of Oil and Gas, Moscow.
- Snurnitsyn, A. 2008. Model of Strategic Competence Centres Comes to Russia. CIO 10, 26-29.